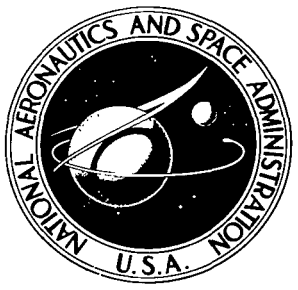
NASA TECHNICAL NOTE

NASA TN D-6364



ACOUSTICAL MEASUREMENTS OF THE VORTEX NOISE FOR A ROTATING BLADE OPERATING WITH AND WITHOUT ITS SHED WAKE BLOWN DOWNSTREAM

by James Scheiman, David A. Hilton, and James P. Shivers

Langley Research Center
Hampton, Va. 23365

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION • WASHINGTON, D. C. • AUGUST 1971

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.
NASA TN D-6364		

4. Title and Subtitle	5. Report Date
ACOUSTICAL MEASUREMENTS OF THE VORTEX NOISE FOR A ROTATING BLADE OPERATING WITH AND WITHOUT ITS SHED WAKE BLOWN DOWNSTREAM	August 1971
	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
James Scheiman, David A. Hilton, and James P. Shivers	L-7715
	10. Work Unit No.
	760-76-01-04

9. Performing Organization Name and Address	11. Contract or Grant No.
NASA Langley Research Center Hampton, Va. 23365	
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address	Technical Note
National Aeronautics and Space Administration Washington, D.C. 20546	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

Tests to make acoustical measurements of rotating-blade vortex noise were conducted at the Langley Research Center. Measurements were made for two different blade sections with several tip shapes. The blades were operated in their own shed wake and also with the shed wake blown downstream. The results are tabulated and presented as the 1/3-octave-band acoustical amplitude along with the corresponding test conditions. Preliminary evaluation indicates that the tip-shape changes had very little effect on the overall sound pressure level. The results confirm that the acoustical radiation is related to the form drag. Introducing axial velocity to blow away the blade shed wake for a rotating blade of circular cross section resulted in an increase in the overall noise level while the overall noise level decreased for an airfoil-section blade.

17. Key Words (Suggested by Author(s))	18. Distribution Statement
Noise Vortex noise Rotating blade noise	Unclassified – Unlimited

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*
Unclassified	Unclassified	86	$3.00

*For sale by the National Technical Information Service, Springfield, Virginia 22151

ACOUSTICAL MEASUREMENTS OF THE VORTEX NOISE FOR A ROTATING BLADE OPERATING WITH AND WITHOUT ITS SHED WAKE BLOWN DOWNSTREAM

By James Scheiman, David A. Hilton, and James P. Shivers
Langley Research Center

SUMMARY

An investigation has been made in the Langley full-scale tunnel and in the outdoors to determine some of the characteristics of vortex noise generated by a rotating-blade system. The rotating blade was operated at zero lift, first in its shed wake in the wind tunnel without wind, and then with wind to impose a small axial velocity which blew the shed wake downstream before passage of the following blade. Acoustical measurements were made for two configurations. One was a round pipe which was tested with the ends open and with several tip shapes installed, the other was a symmetrical airfoil section. The complete basic data are presented in tabular form and a part of the data is plotted for ready examination of a few of the key points for which the investigation was run.

A cursory evaluation indicates that the tip-shape changes had very little effect on the overall sound pressure level. The results also indicate that the acoustical radiation is related to the form drag. The introduction of the small axial velocity resulted in an increase in the overall noise level for the circular-cross-section blade while the overall noise level decreased for the airfoil-section blade.

INTRODUCTION

Rotor noise is a major operating problem of helicopter and propeller-driven aircraft. The development of satisfactory methods for predicting so-called vortex noise has been an objective of the helicopter and propeller industry but a lack of experimental data has prevented the achievement of this goal. The origin of vortex noise has been attributed by some scientists to Von Kármán vortex shedding and by others to turbulence ahead of the blade. For example, reference 1 assumes that blade surface pressures can be separated into those giving rise to normal lift and drag and those associated with the shedding of eddies resulting from pressure oscillations on bluff bodies, namely vortex street effects, whereas, reference 2 indicates that the vortex noise is associated with the random turbulence ahead of the blade which in turn causes surface-pressure oscillations.

A shortage of experimental information on vortex noise has seemed the major impediment to devising a method of correlating theory with test results. The present investigation was performed in order to help overcome this obstacle. It consisted of noise measurements during tests of a rotor at zero lift for two blade configurations with various tip shapes. The tests included rotor operation with the blade rotating in its own shed wake and with the shed wake blown downstream. In order to make the data available to others working in the field at the earliest possible date, the complete data from the tests are presented herein in tabulated form with only a cursory analysis to indicate some of the more obvious characteristics.

SYMBOLS

Values are given in both SI and U.S. Customary Units. The measurements and calculations were made in U.S. Customary Units.

D	rotor diameter, m (ft)
N	measured average rotor rotational speed, rpm
N_0	nominal rotor rotational speed, rpm
R	rotor blade radius, m (ft)
r	hall radius, m (ft)
V	axial velocity, m/sec (ft/sec)
x,y,z	coordinates of microphone positions, m (ft)
Ω	angular velocity, rad/sec

APPARATUS AND TESTS

The object of the tests was to provide information to show whether the vortex noise of a rotor is related to blade shape, profile drag, or to the turbulence of the air. These factors are important with regard to basic understanding of the problem and relate to basic assumptions of various theoretical treatments. The basic concept of the test program was to make sound pressure measurements for a two-bladed rotor at zero lift with blades of high-drag and low-drag configurations operating in their own turbulent wake and

with the wake blown away. The tests were run mainly in a wind tunnel, with the rotor shaft alined with the direction of the wind so that with wind on the wake could be blown away. The wind speeds used were very low and were intended only to blow the blade wake away before it was encountered by the following blade. The wind tunnel was an open-test-section type with a large test chamber. The measurements were subject to the test-chamber reverberation effects, therefore tests were also made outdoors at zero wind velocity for correlation. These outdoor tests were performed in an attempt to achieve a free-field condition.

Rotor Blades

A two-bladed rotor system was used for the investigation. The blades were 3.05 m (10 ft) in diameter with a maximum thickness of 5.08 cm (2 in.). Two differently shaped blades were used. One was simply a piece of steel tubing of a circular cross section. Figure 1 is a photograph of this cylindrical blade and the different blade-tip modifications tested. The second rotor model consisted of two variations of an NACA 0012 airfoil section fabricated around a 5.08-cm-diameter (2-in.) cylindrical steel spar. The blade chord was approximately 42.5 cm (16.7 in.). The airfoil quarter-chord axis was coincident with the axis of the cylindrical spar. The airfoil section extended from the 0.305-m (1-ft) radius to the blade tip. One variation had zero blade twist and the other had a helical twist, such that with the proper combination of rotational speed and axial velocity there would be zero lift on the section throughout the blade span. Photographs of the twisted and untwisted blades are shown in figures 2(a) and 2(b), respectively. Two different blade-tip shapes were tested. One of the tips was a squared-off end and the other tip was a body of revolution with a radius equal to one-half the blade thickness at the chord station. Table 1 describes the various configurations of both blades and gives their configuration numbers. A rudimentary attempt was made to evaluate vortex-noise variations related to airfoil shape changes. This was accomplished by gluing spoilers on the untwisted airfoil section throughout the span length. The spoilers measured 0.318 cm (1/8 in.) thick by 1.27 cm (1/2 in.). Photographs of the airfoil cross section without and with the spoilers are shown in figures 2(c) and 2(d), respectively. Figure 3 indicates the location of the spoilers on the blade. No. 14 grit was applied to the leading edges of some of the configurations in order to cause the boundary layer to be fully turbulent (see fig. 3).

Test Setup

The rotor was driven by a variable-frequency 746-kW (1000-hp) electric motor with more than adequate torque and good rotational-speed control. The tests in the wind tunnel were made in the Langley full-scale tunnel, and a photograph of the model setup in the tunnel is shown in figure 4. The rotor rotational axis was in the center of the tunnel and approximately 3.96 m (13 ft) above the groundboard. The microphone locations for

the wind-tunnel tests (indoor) are given in table 2. A photograph of the model setup for the outdoor tests is shown in figure 5. The rotor axis was alined parallel to and approximately 2.44 m (8 ft) above the ground level. The outdoor microphone locations are given in table 2. These outdoor tests were conducted at a near zero wind condition only.

Data Acquisition

The noise measurement equipment used for these tests is a commercially available system and certain components of these systems can be seen in the photographs of figure 6. The microphones were a piezo-electric ceramic type having a 2.54-cm-diameter (1-in.) active diaphragm and frequency response that was flat to within $\pm 1\frac{1}{2}$ dB over the range of 20 to 12 000 Hz. For the indoor tests the outputs of 6 microphone channels were recorded on one 7-channel FM magnetic-tape recorder. For the outdoor tests 12 microphone systems were used and the output of these systems was recorded on two 7-channel FM magnetic-tape recorders. All measurements were made in accordance with the recommendations of reference 3. The entire sound measurement system was calibrated immediately before and after the acoustical measurements by means of discrete frequency calibrators. The acoustical measurements were accepted only when the recorded pre- and post-calibration amplitude was within 1/4 dB. In addition, the acoustical measurements were accepted only when the recorder voltages for each microphone were between peak-to-peak root-mean-square values of 1.0 and 2.8 volts.

For both the indoor and outdoor measurements, one of the microphones was oriented so that its diaphragm was parallel to the reflecting surface. For the outdoor tests microphone number 11 was so oriented and positioned in the ground. During the indoor tests microphone number 2 was so oriented and positioned in the wind-tunnel groundboard. During all tests microphone wind screens (see fig. 6(b)) were employed on all microphones except for microphone number 2 in the indoor tests. These wind screens have been shown to have no appreciable effect on the noise measurements below a frequency of about 15 000 Hz.

Data Reduction

The data obtained from these tests were reduced by analog and by digital methods. The analog method was used to cross check data as it was obtained. In order to obtain the detailed 1/3-octave-band information contained in this report digital computational methods were used. The data from the original analog tapes were played into a 1/3-octave-band parallel filter set. The output of the filter set was digitized and was then sampled every 1/2 second. Thus at each 1/2-second interval a complete 1/3-octave-band listing was obtained. Samples were taken over a 30-second interval and the result was averaged to obtain the 1/3-octave-band amplitude listed in table 6. The corresponding overall level was then computed by combining the averaged 1/3-octave-band

amplitude. It should be pointed out that the lowest band does not include the fundamental blade-passage frequency.

Tests

The test conditions and the corresponding run numbers are presented in tables as follows:

Table	Subject
3	Ambient-noise tests in wind tunnel
4	Cylindrical-blade tests
5	NACA 0012 airfoil-blade tests

The rotor rotational speed was structurally limited. The cylindrical blade was limited to 950 revolutions per minute which corresponds to a rotational tip speed and tip Reynolds number of approximately 151.2 m/sec (496 ft/sec) and 0.53×10^6, respectively. The NACA 0012 airfoil-section blade was limited to a rotational speed of 850 revolutions per minute which corresponds to a rotational tip speed and tip Reynolds number of approximately 135.6 m/sec (445 ft/sec) and 3.96×10^6, respectively.

DISCUSSION OF TABULATED DATA

The test operating conditions are given in tables 3, 4, and 5 according to run numbers. The tabulated noise data are given in root-mean-square values in table 6 in accordance with the run numbers.

Wind-Tunnel Tests

The ambient noise levels in the wind tunnel were not judged to be time dependent. Table 3 gives the test conditions for which ambient indoor noise data were recorded. Where a rotational speed is listed in table 3 the rotor drive motor was running with the blades removed. The measured data from the indoor tests are presented without corrections for reverberation effects. A general indication of the magnitude and significance of reverberation effects is afforded, however, by comparison with the outdoor tests. Also, a preliminary calibration of reverberation effects in the test chamber has been made and some of the results of these tests are presented to assist in evaluation of the indoor-test results.

There is some question about the validity of measurements from microphone number 2 which was located in the surface of the tunnel groundboard in order to obtain reflection effects. During the early part of the tests it was noticed that the microphone was not vibration isolated from the groundboard. Since the microphones are vibration sensitive it is possible that extraneous information is given for this microphone. Also, since

microphone number 4 was only a few feet from the test-chamber wall the radiated rotor noise at this distance is not appreciably above the ambient level (low signal to noise ratio). Therefore the data for this microphone have been omitted from table 6.

During the wind-tunnel tests of the circular cross-section blade with leading-edge grit (model 03) some structural instabilities were encountered. The grit was applied throughout the span 1.27 cm (0.5 in.) on each side of the line through the blade tangential-velocity vector (see fig. 3(b)). The purpose of the grit was to evaluate Reynolds number effects. With the introduction of axial velocity the model with the grit became aerodynamically unsymmetrical even though the axial- to tangential-velocity ratio was quite small. It is believed that this small aerodynamic dissymmetry resulted in some aerodynamic lifting which developed into a blade-flapping flutter instability. As a result of this instability (structural limit) the rotor rotational speeds had to be restricted in runs 55 through 61 (table 4).

Outdoor Tests

The outdoor tests were run in the early morning and the recorded noise data were in some cases time dependent. The test conditions for which ambient outdoor noise data were recorded are given in tables 4(b) and 5(b). These test conditions are tabulated chronologically in the order in which the tests were performed.

The outdoor tests were performed in near zero wind conditions. As can be seen from the ambient test runs (i.e., runs 74, 80, 101, 106, 111, 112, 117, and 122) the background noise was quite low. The tests were performed over a grassy area. The ground reflection effects can be evaluated by comparing the tabulated sound pressure levels on microphones 10 and 11.

Some difficulties were encountered in reading the revolution-per-minute recorder for the rotor during the outdoor tests of the airfoil-section blade. For these cases the revolutions per minute were determined from records of the blade inplane strain gages (gravity component of bending moments) and are given in table 5 as determined although the listed values are perhaps farther away from the nominal values than desired. The nominal values are 400, 625, 700, 850, and 900 rpm.

DISCUSSION OF RESULTS

A preliminary evaluation and analysis of a portion of the data have been completed and the results are presented herein.

Reverberation Effects

An evaluation of the reverberation effects of the wind-tunnel test chamber is published in reference 4. This evaluation was obtained by making acoustical noise

measurements at various distances and directions from a known sound source located above the test platform. In addition, the reverberation time around the test section was also measured. These measurements yielded the so-called hall radius which is defined as the distance from the source where the sound pressure of the direct field equals the space-average sound pressure of the reverberant field. Further, with the reverberant sound pressure equal to the direct-field sound pressure (at one hall radius from the source) the resulting measurement will be 3 dB above the corresponding free-field measurements and at a distance of one-half a hall radius this difference would be 1 dB. These results have been extrapolated to determine the hall radius for a few of the models and operating conditions for the tests reported herein.

The hall radius varies with the directivity and frequency of the noise source. The directivity and frequency were determined from the outdoor tests which were all run at a near zero-wind condition. Therefore, the test-chamber hall radius was determined without wind in the tunnel. Both models, the blade with the circular cross section and the blade with the NACA 0012 airfoil section, were evaluated for various rotational speeds and 1/3-octave-band-center frequencies.

The ratio of hall radius to rotor diameter r/D for different directions from the source showing the effect of source frequency and rotor rotational speed is plotted in figures 7 and 8 for model 01 (circular cross-section blade) and model 10 (airfoil-section blade), respectively. The zero-degree azimuth position is alined with the rotor rotational axis (using the right-hand rule). The center-band frequencies were limited to a range from 125 to 2000 Hz because the original test-chamber acoustical evaluation indicated that the 1000-Hz frequency band resulted in the smallest hall radius and that for frequencies less than 125 Hz or greater than 2000 Hz the hall radius is greater than that for a frequency of 250 Hz. This assumes that the directivity of the source is approximately the same for all frequencies, which is a valid assumption. This range covers the worst reverberation conditions. Knowing the nominal locations of the microphones from table 2, it can be seen in figures 7 and 8 that microphones number 1, 2, 3, and 5 were inside of or near the hall radius with the exception of the 1000-Hz frequency band. Therefore the tabulated data are between 1 and 3 dB too high due to the proximity to the reverberant field (1 dB corresponds to a microphone position located at one-half of the hall radius). Also, figures 7 and 8 indicate that microphone number 6 is a greater distance from the source than one hall radius for all of the plotted data. Therefore, microphone number 6 is in the reverberant field, and the tabulated data are at least 3 dB too high due to the proximity of the reverberant field.

Comparisons of indoor and outdoor noise frequency spectra are presented in figures 9 and 10 for model 01 (circular cross section) and model 10 (airfoil section), respectively. The comparison is for zero axial velocity and for one microphone position at 2 rotor diameters' distance and alined along the axis of rotor rotation.

The comparison of the indoor and outdoor results for the cylindrical blade (see fig. 9) denotes quite good agreement in the amplitude of the spectrum distribution. The correlation of the amplitude of the spectrum distribution between indoor and outdoor results for the airfoil-section blade (see fig. 10) is also quite good, but not as good as for the cylindrical blade. It appears that there is approximately a 7-dB difference between indoor and outdoor results for the blades having NACA 0012 airfoil sections whereas the tests of the cylindrical blades (see fig. 10) indicate approximately a 2-dB difference. This result does not seem consistent with the computations and discussion of the hall radius in figures 7 and 8.

A further attempt was made to evaluate the reverberation characteristics of the test chamber through the use of the inverse square law. Recall that doubling the distance is equivalent to a 6-dB decrease in overall sound pressure level. Figure 11 shows a comparison of the overall sound pressure level for two microphones with nominal positions of 2 and 6 rotor diameters' distance along the rotor rotational axis. A difference of 9.6 dB in sound pressure level would be expected if the noise source were in a free field, whereas a zero difference would indicate a completely reverberant field. The 5- to 6-dB differences in the data shown in figure 11 indicate that the test chamber is a reverberant chamber, at least in the direction along the rotor rotational axis.

Certainly additional evaluation of the reverberant-field effects is desired before performing a very detailed analysis of the results. Hence, all further preliminary evaluation in this report is restricted to the use of overall sound pressure levels and is confined to the indoor measured data, which covered the most test conditions.

Effect of Tip Shape

Vortex-noise radiation has been shown to be proportional to the blade-tip velocity to the 5.5 power (ref. 5). By far the largest portion of the noise level, therefore, originates from the blade tip. Thus, it is reasoned that changes in the blade-tip fluid-flow conditions might produce large changes in the noise level. Wind-tunnel tests of stationary circular cylinders (refs. 6 and 7) with various tips have shown a significant effect of tip shape. In order to confirm this influence on rotating blades, various geometric tip shapes were tested (see fig. 1). The preliminary results of a portion of these tests are shown in figure 12(a) for microphone number 5 and in figure 12(b) for microphone number 1. From both of these figures, it is evident that the various blade-tip shapes tested did not produce any significant differences in the overall sound pressure levels for the two different microphone locations. A cursory review of the tabulated data for the blade with the NACA 0012 airfoil section shows the same results, namely no noticeable noise-radiation differences with blade-tip shape changes.

Effect of Reynolds Number

Figure 13 shows the effect of grit on the leading edge of the cylindrical blade. The grit was intended to indicate the effect of Reynolds number by causing the boundary layer to be turbulent at all values of Reynolds number, as is the case at high Reynolds number without the grit. Model 03 is the blade with No. 14 grit applied to the leading edge. The critical Reynolds number for this round section is about 4×10^5 (ref. 8) which for a 5.08-cm (2-in.) reference length corresponds to a velocity of about 114 m/sec (375 ft/sec). This critical speed is indicated by the tick mark on the abscissa of figure 13. Blade-section speeds above this critical value are associated with turbulent boundary-layer flow whereas speeds less than this critical value are associated with laminar flow for model 01 which does not have the strip of grit. It is evident from figure 13 that at tip speeds below that for critical Reynolds number model 03 with the turbulent boundary layer produces a lower sound pressure level than model 01 with a laminar boundary layer. Other investigators have shown that the radiated sound pressure level is proportional to the flow velocity to some power. This relationship will appear as a straight line with a slope equal to a power of the velocity on a decibel-velocity plot since the decibel scale is a logarithmic function. From figure 13 it appears that two parallel straight lines (same power) can be drawn through the data, one line through the laminar data and another through the turbulent data. These results are consistent with those in reference 9.

Effect of Form Drag

Figure 14 presents a comparison of the sound pressure level for the two different blade cross sections (circular and NACA 0012 airfoil) with and without axial velocity and for two different microphone locations. The results indicate that even though the frontal areas for the two blades are the same, the blade with the circular section makes a significantly larger noise level both with and without axial fluid flow. This conclusion is in agreement with the conclusions in reference 10, where it is stated that the intensity of vortex sound increases in proportion to the form drag. However, Yudin (ref. 10) encountered difficulty separating rotational and vortex noise with the commencement of axial flow. This difficulty is not believed present in this investigation because the blades did not produce lift. Acoustically, it is concluded that although they have the same frontal area the cylindrical and airfoil blades behave differently and that this difference exists when the rotor operates with or without axial velocity.

Effect of Turbulence

An attempt was made to determine more explicitly the origin of vortex noise. A preliminary evaluation of the results is presented in figure 15 which depicts the effect,

for two different microphone positions, of imposing a small axial velocity on the rotating blades to blow their shed wake away before the passage of the following blade. Recall that the rotor with the airfoil section had a helical twist (model 20) and required precise combinations of rotational and axial velocity to keep zero lift on the entire blade span. Therefore the axial velocity for this model varied continuously with each change in rotational speed. The results in figure 15 indicate that the introduction of axial velocity on the cylindrical blade increases the overall sound pressure level, whereas, the introduction of axial velocity on the airfoil-bladed rotor resulted in a decrease in the overall sound pressure level.

The reason for the foregoing results cannot be definitely established in this preliminary analysis, but the fact that model 20 with the NACA 0012 airfoil section produced less noise with a small axial velocity than when rotating in its own shed wake might be explained as follows. An airfoil rotating in its own wake produces some "rotational noise" due to lift. This lift will fluctuate because of velocity fluctuations in the shed wake. These fluctuations in lift do not occur when the shed wake is blown downstream thus resulting in a decreased noise level. Small axial-velocity fluctuations (present when the blade rotates in its own shed wake) produce relatively large lift fluctuations on an airfoil section because of its high lift-curve slope but produce zero lift on a cylindrical blade.

On the other hand, the fact that model 01 with a circular cross section produced more noise when its shed wake was blown away by the axial velocity cannot be explained. Introducing axial velocity certainly increases the dynamic pressure on the blades. However, the addition of the axial- and tangential-velocity vectors will not produce a sufficient increase in dynamic pressure to explain the 2- to 3-dB increase in sound level. In other words, for a straight line through the zero-axial-velocity data (recalling Reynolds number effects and therefore neglecting the two highest speed points) a 2- to 3-dB increase corresponds to an increase in the velocity vector of 1.8 m/sec (6 ft/sec). (See fig. 13.) This is an order of magnitude larger than what was actually achieved with the introduction of axial velocity.

CONCLUDING REMARKS

The investigation was conducted at the Langley Research Center to define further the characteristics of vortex noise generated by a rotating blade system. Tests were made in a wind tunnel and also outdoors for two differently shaped blades with various end tips. One was of circular cross section and the other an airfoil section. The test-chamber hall radius was determined for these two blades in a wind-off condition. The complete basic data are presented in tabular form in 1/3-octave bands to make them available to others working on the same problem. A part of the data is plotted for examination of a few of the key points. This preliminary analysis of the data shows the following results:

1. A comparison of the 1/3-octave-band spectrum distribution for two models tested in the wind tunnel and outdoors is favorable. Evaluation of the wind-tunnel reverberation from the inverse-square law of the overall sound pressure levels is also relatively good.

2. The tip shapes tested did not show any appreciable difference in overall sound pressure level.

3. Even though the frontal area of both blades was the same, the radiated noise levels were quite different. The cylindrical blade is much the noisier of the two which confirms previously found results indicating a direct relationship between increased noise level and increased form drag.

4. The addition of grit to the leading edges of the blades to obtain a turbulent flow and decrease the section drag reduced the overall sound pressure level. This result also confirms the effect of form drag.

5. The introduction of axial velocity to blow away the turbulent shed wake of one blade before the passage of the following blade caused a decrease in the noise level of the airfoil-section blade and an increase in the noise level of the cylindrical blade. The reason for this increased noise level is presently unexplained.

Langley Research Center,
National Aeronautics and Space Administration,
Hampton, Va., June 23, 1971.

REFERENCES

1. Sadler, S. Gene; and Loewy, Robert G.: A Theory for Predicting the Rotational and Vortex Noise of Lifting Rotors in Hover and Forward Flight. NASA CR-1333, 1969.

2. Lowson, M. V.; and Ollerhead, J. B.: A Theoretical Study of Helicopter Rotor Noise. J. Sound Vib., vol. 9, no. 2, Mar. 1969, pp. 197-222.

3. Anon.: Measurements of Aircraft Exterior Noise in the Field. ARP 796, Soc. Automot. Eng., Inc., June 15, 1965.

4. Vêr, Istvân L.; Malme, Charles I.; and Meyer, Eugene B.: Acoustical Evaluation of the NASA Langley Full-Scale Wind Tunnel. Rep. No. 2100 (Contract No. NAS 1-9559), Bolt Beranek and Newman, Inc., Jan. 22, 1971. (Available as NASA CR-111868.)

5. Stowell, E. Z.; and Deming, A. F.: Vortex Noise From Rotating Cylindrical Rods. NACA TN 519, 1935.

6. Keefe, R. T.: An Investigation of the Fluctuating Forces Acting on a Stationary Circular Cylinder in a Subsonic Stream and of the Associated Sound Field. UTIA Rep. No. 76, Inst. Aerophys., Univ. of Toronto, Sept. 1961.

7. Gerrard, J. H.: Measurements of the Fluctuating Pressure on the Surface of a Circular Cylinder. Pt. 1. Cylinder of 1" Diameter. F.M.2637, Brit. A.R.C., Jan. 29, 1958.

8. Welsh, C. J.: The Drag of Finite-Length Cylinders Determined From Flight Tests at High Reynolds Numbers for a Mach Number Range From 0.5 to 1.3. NACA TN 2941, 1953.

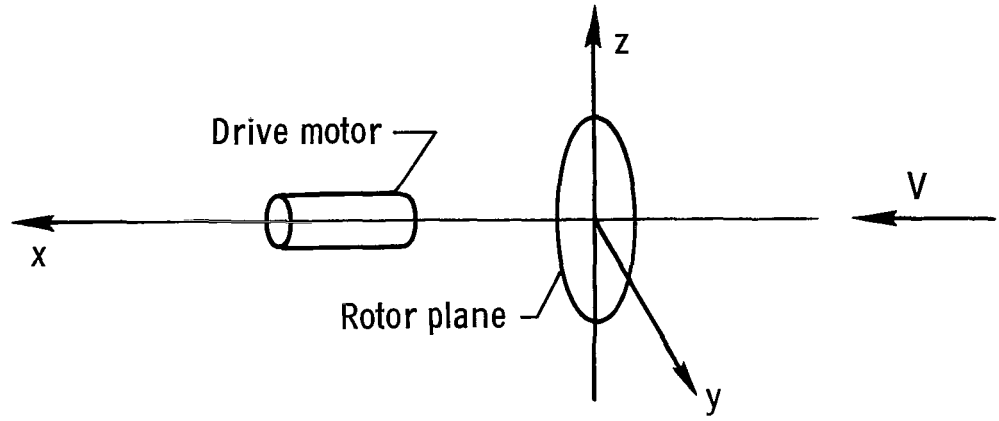
9. Rimskiy-Korsakov, A. V., ed.: Physics of Aerodynamic Noise. NASA TT F-538, 1969.

10. Yudin, E. Y.: On the Vortex Sound From Rotating Rods. NACA TM 1136, 1947.

TABLE 1.- MODEL CONFIGURATION NUMBER AND DESCRIPTION

Configuration	Blade description	Blade-tip description
00	5.08-cm-diameter (2-in.) cylinder	Open end of pipe
01	5.08-cm-diameter (2-in.) cylinder	Squared tip
02	5.08-cm-diameter (2-in.) cylinder	5.08-cm-diameter (2-in.) semisphere
03	Same as configuration 01 with No. 14 grit added to leading edge (see fig. 3(b))	Squared tip
04	5.08-cm-diameter (2-in.) cylinder	10.16-cm-diameter (4-in.) end plate
10	Untwisted NACA 0012 airfoil	Squared off
11	Untwisted NACA 0012 airfoil	Body of revolution
20	Twisted NACA 0012 airfoil	Squared off
21	Twisted NACA 0012 airfoil	Body of revolution
12	Same as configuration 10 with No. 14 grit added to leading edge (see fig. 3(a))	Squared off
13	Same as configuration 12 with aft chord spoilers (see figs. 2(d) and 3(a))	Squared off
14	Same as configuration 13 with forward chord spoilers (see figs. 2(d) and 3(a))	Squared off

TABLE 2.- MICROPHONE LOCATIONS



Microphone number	Actual locations						Nominal location	
	x		y		z		Distance from rotor center, in rotor diameters	Degrees from X-axis
	m	ft	m	ft	m	ft		
Inside Langley full-scale tunnel								
1	-4.47	-14.67	4.3	14.08	-0.61	-2.00	2	135
2	0	0	-.10	-.33	-4.07	-13.33	1.6	90
3	4.32	14.17	4.32	14.17	-.30	-1.00	2	45
4	-.23	-.75	-15.2	-49.75	0	0	5	90
5	-6.1	-20.00	0	0	.05	.17	2	0
6	-16.84	-55.25	0	0	-.20	-.67	5.5	0
Outdoors in free field								
7	-16.7	-54.83	0	0	0	0	5.5	0
8	-11.8	-38.67	10.9	38.92	0	0	5.5	135
9	12.00	39.33	11.9	39.00	0	0	5.5	45
10	-5.85	19.17	0	0	0	0	2	0
11	-6.61	-21.67	0	0	-2.44	-8.00	2	0
12	-5.51	-18.08	2.32	7.58	0	0	2	157.5
13	-4.2	-13.75	4.3	14.08	0	0	2	135
14	-2.24	-7.33	5.62	18.42	0	0	2	112.5
15	.10	.33	6.1	20.00	0	0	2	90
16	2.47	8.08	5.62	18.42	0	0	2	67.5
17	4.42	14.5	4.30	14.08	0	0	2	45
18	5.67	18.58	2.78	9.08	0	0	2	22.5

TABLE 3.- AMBIENT NOISE IN WIND TUNNEL

Run	N, rpm	V	
		m/sec	ft/sec
1	0	0	0
2	↓	↓	↓
3			
4			
5			
6			
7			
8			
9	847		
10	847	1.52	5.0
11	700	6.1	20.0
12	848	6.1	20.0

TABLE 4.- CYLINDRICAL-BLADE TESTS

(a) Wind-tunnel tests

Model configuration	Run	N, rpm	V		Run number of identical ambient conditions	Model configuration	Run	N, rpm	V		Run number of identical ambient conditions
			m/sec	ft/sec					m/sec	ft/sec	
00	13	403	0	0	1	02	43	402	0	0	1
	14	628					44	624			1
	15	700					45	701			3
	16	850			3		46	852			
	17	900			3		47	899			
	18	952					48	849	1.52	5.0	
	19	399	1.52	5.0	10		49	899	1.52	5.0	
	20	627					50	403	6.1	20.0	
	21	700					51	624			
	22	849					52	699			
	23	902					53	848			
	24	948					54	900			
	25	400	6.1	20.0		03	55	401	0	0	2
	26	626					56	626			2
	27	698					57	698			3
	28	851					58	625	1.52	5.0	
	29	899					59	701	1.52	5.0	
	30	950					60	628	6.1	20.0	
01	31	400	0	0	1		61	699	6.1	20.0	
	32	624				04	62	400	0	0	2
	33	700					63	624			2
	34	851			2		64	700			5
	35	900			2		65	850			
	36	850	1.52	5.0	10		66	901			
	37	903	1.52	5.0	10		67	848	1.52	5.0	9
	38	401	6.1	20.0			68	901	1.52	5.0	
	39	626					69	402	6.1	20.0	
	40	701					70	626			
	41	850					71	700			
	42	900					72	850			
							73	897			

(b) Outdoor tests

Model configuration	Run	N, rpm	V	
			m/sec	ft/sec
01	74	0	0	0
	75	403		
	76	620		
	77	703		
	78	850		
	79	907		
	80	0		

TABLE 5.- NACA 0012 AIRFOIL-BLADE TESTS

(a) Wind-tunnel tests

Model configuration	Run	N, rpm	V		Run number of identical ambient conditions
			m/sec	ft/sec	
11	81	177	0	0	3
	82	403			3
	83	624			3
	84	701			3
	85	849			5
10	86	175			1
	87	401			1
	88	626			
	89	701			
	90	852			
21	91	175	1.25	4.1	
	92	406	2.86	9.4	
	93	627	4.48	14.7	
	94	700	5.0	16.4	
	95	850	6.1	20.0	
20	96	177	1.34	4.4	
	97	402	2.86	9.4	
	98	625	4.48	14.7	
	99	700	5.0	16.4	
	100	850	6.1	20.0	

(b) Outdoor tests

Model configuration	Run	N, rpm	V	
			m/sec	ft/sec
10	101	0	0	0
	102	400		
	103	630		
	104	715		
	105	862		
	106	0		
12	107	379		
	108	630		
	109	709		
	110	873		
	111	0		
13	112	0		
	113	410		
	114	646		
	115	715		
	116	870		
14	117	0		
	118	413		
	119	640		
	120	720		
	121	870		
	122	0		

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS

RUN NUMBER 1

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3	62	49	55	52	49	51	46	46	57	46	46	42	41	40	36	32	30	30	24	16	20	22	20	29	20
4																									
5																									
6																									

RUN NUMBER 2

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	68	57	58	58	58	57	56	54	59	55	54	54	51	52	47	43	55	53	35	31	22	18	16	20	57
2	70	57	61	59	59	60	58	56	60	56	55	56	53	54	50	47	61	59	37	34	28	21	25	35	27
3	67	55	59	56	56	58	57	55	56	56	54	54	52	50	46	42	55	53	35	33	27	24	21	22	38
4																									
5	68	56	59	57	56	59	57	54	57	55	54	54	51	51	47	42	58	56	34	31	23	21	10	17	15
6	67	54	57	56	56	58	57	53	55	53	53	54	50	51	47	43	58	56	37	32	26	20	15	12	25

RUN NUMBER 3

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	67	58	55	54	53	56	53	52	57	53	53	54	53	54	47	44	59	57	37	31	25	17	14	20	50
2	69	57	57	57	57	58	56	55	60	55	55	56	53	54	50	47	59	58	40	34	31	25	18	23	22
3	69	61	58	55	55	61	55	55	59	56	55	55	53	55	48	43	56	55	37	33	30	25	22	23	20
4																									
5	67	57	55	53	52	58	53	54	58	54	54	53	53	55	47	43	59	57	36	31	27	20	15	18	19
6	66	55	53	52	51	54	52	52	54	51	51	52	50	49	46	43	60	58	39	32	27	21	13	18	18

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 4

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3	64	45	56	56	50	52	34	46	60	56	46	45	37	37	29	29	26	31	25	22	17	20	24	30	39
4																									
5																									
6																									

RUN NUMBER 5

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	71	62	65	60	59	60	56	54	61	57	54	55	52	52	49	47	57	56	36	34	26	25	25	25	24
2	72	63	66	61	58	61	57	57	64	58	56	57	54	55	52	49	61	60	40	39	32	26	27	27	25
3	70	58	62	64	60	60	55	55	61	57	54	54	53	52	48	44	56	55	36	34	28	23	20	23	24
4																									
5	69	55	59	61	59	57	55	53	57	57	53	54	51	53	48	45	58	57	35	33	25	26	26	27	35
6	69	57	60	60	57	57	54	53	61	53	52	54	50	50	48	45	59	58	37	34	27	24	19	22	19

RUN NUMBER 6

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3	65	52	56	56	51	55	40	47	61	58	49	47	40	39	34	29	25	30	24	23	17	21	24	30	29
4																									
5																									
6																									

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 7

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3	66	51	56	57	52	55	40	47	62	60	49	47	40	39	33	30	25	30	24	21	16	21	25	31	27
4																									
5																									
6																									

RUN NUMBER 8

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3	67	59	57	57	55	57	50	51	60	58	51	51	49	46	42	39	39	38	33	30	31	31	31	36	29
4																									
5																									
6																									

RUN NUMBER 9

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	69	58	60	61	57	61	54	53	60	57	57	54	52	54	54	49	47	45	41	42	42	39	35	34	21
2	72	61	65	60	59	64	57	60	62	59	57	57	57	57	60	56	55	52	49	49	49	43	40	37	38
3	71	56	58	64	59	66	55	54	62	58	55	53	51	53	61	54	48	49	47	44	47	46	40	38	24
4																									
5	68	57	59	59	57	57	54	53	61	56	53	52	51	53	55	50	48	44	39	39	39	35	31	25	27
6	67	56	60	59	54	57	52	51	57	53	51	51	49	51	50	46	46	43	38	37	37	34	25	28	22

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 10

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	72	59	61	61	58	68	56	55	60	59	61	54	52	53	53	50	47	44	40	41	42	38	34	33	24
2	75	63	67	61	61	71	58	60	63	61	61	57	57	57	62	57	55	52	50	49	49	45	40	39	25
3	73	55	58	64	60	68	56	56	64	59	59	54	52	52	58	52	47	48	47	44	47	46	41	39	25
4																									
5	70	57	59	61	60	63	55	56	63	58	58	54	51	51	53	49	47	44	38	39	39	37	33	27	29
6	69	57	61	61	56	64	53	52	58	55	55	52	50	50	50	47	44	43	38	37	37	34	24	23	28

RUN NUMBER 11

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	72	63	64	61	59	66	56	56	60	57	58	62	58	56	52	47	47	45	38	41	40	36	36	32	27
2	76	66	66	67	65	70	60	61	65	61	60	66	62	59	59	52	56	53	47	48	50	42	38	33	28
3	74	65	61	63	63	69	57	57	62	59	57	64	60	56	53	46	48	46	42	43	43	40	37	32	59
4																									
5	71	55	58	63	62	65	55	56	57	56	55	63	59	53	50	46	46	44	38	38	36	29	25	13	51
6	69	54	57	61	57	62	54	53	57	55	54	60	57	54	49	45	44	43	37	35	33	30	29	34	39

RUN NUMBER 12

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	72	63	64	62	60	66	56	55	60	58	58	60	58	55	54	48	46	44	38	41	40	37	36	32	24
2	76	66	66	67	66	71	61	61	65	60	58	65	63	58	59	55	55	52	49	49	49	47	39	37	27
3	74	62	67	64	64	70	58	58	62	59	56	63	61	53	60	52	47	46	44	43	47	46	41	39	36
4																									
5	71	55	58	64	63	65	55	55	57	56	55	62	59	54	53	48	46	44	39	38	38	34	29	24	27
6	69	55	58	62	58	62	53	52	59	55	55	59	57	54	50	46	44	43	38	37	37	34	24	27	14

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 13

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	64	65	69	71	76	78	78	78	75	73	72	69	68	67	64	66	65	58	57	54	53	53	54	50
2	89	69	71	74	76	78	78	79	81	80	79	77	75	74	73	72	74	72	66	65	62	59	57	58	53
3	86	62	65	71	72	76	78	78	79	76	73	71	68	68	65	63	65	64	57	54	53	52	52	53	48
4																									
5	87	62	66	71	72	77	80	80	79	75	73	71	67	67	65	62	65	64	57	56	54	52	51	51	46
6	81	58	61	65	66	71	74	74	74	70	68	66	62	62	61	58	60	59	52	50	49	47	43	45	41

RUN NUMBER 14

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	93	66	68	71	73	77	80	81	84	85	86	85	82	80	78	77	77	76	73	69	68	66	67	68	64
2	97	74	76	80	81	83	83	84	88	89	89	88	86	85	84	84	84	82	79	76	74	71	69	69	64
3	93	65	68	73	75	79	80	81	84	85	85	85	82	79	76	75	76	75	71	68	66	64	64	66	58
4																									
5	94	64	68	72	73	77	80	82	85	86	86	85	81	78	76	75	75	75	71	69	67	65	65	64	55
6	88	60	63	67	67	72	75	76	80	80	81	80	76	73	72	71	71	70	66	64	62	60	58	58	55

RUN NUMBER 15

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	95	69	67	72	73	78	80	81	84	85	87	87	85	83	80	80	80	79	76	73	71	70	70	71	68
2	99	85	77	80	81	83	83	84	88	89	90	90	88	87	86	87	88	86	82	80	77	74	72	73	69
3	94	70	68	73	74	79	80	81	84	85	86	87	85	82	79	78	79	78	74	71	69	67	68	70	62
4																									
5	95	70	68	72	74	78	80	82	85	86	87	88	85	82	79	78	79	78	74	72	70	69	68	67	60
6	90	66	62	67	67	72	75	76	80	81	82	82	79	77	74	74	74	73	70	67	65	63	61	62	60

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 16

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	67	67	73	72	76	78	79	83	85	87	89	89	89	87	85	86	87	82	79	77	76	77	78	75
2	103	91	92	83	81	81	81	83	87	88	90	91	91	91	91	92	93	94	90	86	83	80	79	80	77
3	97	65	66	73	74	77	78	79	83	85	87	89	88	88	86	84	85	85	81	77	75	73	74	76	70
4																									
5	98	72	73	72	73	76	79	80	84	86	88	90	90	88	85	84	84	85	81	78	76	75	75	74	67
6	93	68	69	67	67	71	74	75	79	81	83	85	84	83	81	79	80	81	76	73	71	69	68	69	66

RUN NUMBER 17

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	99	72	77	74	74	76	78	78	83	85	88	90	90	90	89	87	88	89	86	81	79	78	79	80	77
2	104	88	94	84	84	81	80	82	87	88	90	92	92	93	93	93	94	95	92	87	84	81	79	81	77
3	98	74	80	73	74	77	78	79	83	85	87	90	90	90	88	86	87	88	84	79	77	76	76	78	72
4																									
5	99	70	75	72	73	76	79	80	84	86	89	91	91	90	87	86	86	87	84	80	78	77	77	76	70
6	94	71	77	67	66	70	74	75	79	80	83	86	85	85	83	82	82	83	80	75	73	71	70	71	69

RUN NUMBER 18

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	101	69	80	76	78	77	78	79	83	86	88	91	91	92	91	90	90	91	89	84	81	80	81	83	79
2	106	83	96	89	92	83	79	81	87	88	90	93	93	94	95	95	96	97	96	90	86	83	82	83	80
3	100	72	86	78	80	76	78	79	83	86	88	91	91	91	90	88	89	90	86	81	79	77	78	80	74
4																									
5	101	67	78	74	76	77	79	80	85	87	89	92	93	92	90	88	89	89	87	82	80	79	79	79	71
6	96	64	76	70	72	71	74	74	79	81	84	87	87	87	85	84	84	85	83	77	75	73	72	73	71

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 19

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	66	67	70	72	77	78	77	77	75	73	71	69	68	67	66	72	71	60	58	55	54	53	55	49
2	91	72	74	78	79	81	80	80	82	80	78	77	75	75	74	75	80	79	70	67	64	61	58	59	52
3	86	65	66	72	74	78	78	78	78	75	73	71	68	67	65	64	71	70	58	57	55	53	51	52	44
4																									
5	86	63	67	71	72	78	79	79	78	74	72	70	67	66	65	63	71	70	58	56	53	51	49	50	34
6	81	60	62	67	66	72	74	74	73	69	68	66	62	62	61	59	66	65	55	52	50	47	43	45	39

RUN NUMBER 20

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	94	68	70	75	78	81	83	83	85	86	86	85	82	80	78	78	80	78	74	71	68	67	67	68	64
2	100	76	80	84	86	88	87	87	90	90	90	89	87	85	85	86	88	86	82	79	76	73	71	72	67
3	95	68	72	76	80	82	82	83	86	87	86	85	82	79	77	77	78	77	72	69	68	66	65	66	59
4																									
5	94	66	70	75	76	80	82	84	86	87	87	85	82	78	76	76	78	78	72	69	67	65	65	65	56
6	89	62	65	70	70	75	77	79	81	81	82	81	76	74	72	72	73	72	68	64	62	60	57	58	54

RUN NUMBER 21

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	96	71	69	77	78	81	83	83	86	87	88	87	85	84	81	80	82	81	76	74	71	70	70	71	67
2	101	84	79	84	85	87	86	87	91	91	91	90	89	88	87	89	90	89	84	81	79	76	74	75	70
3	96	71	72	76	78	83	82	83	86	87	87	87	85	83	80	79	80	79	74	71	71	68	68	69	61
4																									
5	96	71	71	75	76	80	82	83	86	88	88	88	85	82	79	78	80	80	74	72	70	68	68	68	58
6	91	66	64	70	71	75	77	78	82	82	83	83	80	78	75	74	76	75	70	67	65	63	60	61	57

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 22

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	99	70	70	75	75	79	81	82	85	87	88	90	89	89	87	86	88	88	84	79	77	76	77	78	74
2	104	91	92	85	84	86	85	86	90	90	91	92	92	92	92	93	94	95	92	87	84	81	79	80	76
3	98	70	71	76	77	81	81	82	85	87	88	90	89	88	86	85	86	86	81	78	77	74	75	76	70
4																									
5	99	73	74	75	76	79	81	82	86	88	89	91	90	89	85	84	86	87	83	78	76	75	75	75	67
6	94	68	68	69	70	74	76	77	81	82	85	86	85	84	82	80	81	83	78	73	71	69	67	68	65

RUN NUMBER 23

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	100	72	78	76	77	79	81	82	85	87	89	91	91	90	89	89	90	91	88	82	79	78	78	80	76
2	106	88	94	86	86	85	85	86	90	90	91	93	93	93	94	95	97	98	97	89	86	83	81	82	78
3	99	75	81	76	77	81	82	82	85	87	89	90	90	90	88	87	88	89	85	80	78	76	76	78	72
4																									
5	100	72	78	74	75	79	81	82	86	88	90	92	92	90	87	87	89	89	87	80	78	76	77	77	70
6	95	71	77	70	69	73	76	77	81	82	85	87	86	85	84	83	84	85	82	75	73	71	69	70	68

RUN NUMBER 24

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	102	70	81	77	79	79	80	81	85	87	89	92	92	92	91	91	92	93	91	85	81	80	81	82	78
2	107	82	96	90	92	85	83	84	89	90	91	94	94	95	96	97	99	99	99	92	87	85	83	84	80
3	101	73	86	78	79	80	81	81	85	87	89	91	92	91	90	90	90	91	88	82	80	78	78	80	73
4																									
5	101	67	78	75	77	78	80	81	86	88	90	93	93	92	89	89	91	91	90	83	80	78	79	79	71
6	96	64	75	71	73	73	75	76	81	82	85	88	87	87	85	85	86	87	85	78	75	73	71	72	69

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 25

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	87	66	66	67	68	77	82	81	75	70	70	69	66	66	65	62	62	62	59	58	55	54	54	55	50
2	87	68	68	70	71	76	80	79	77	75	75	74	72	72	71	70	71	70	68	67	64	60	58	58	53
3	86	65	64	67	69	77	82	81	75	70	69	69	66	65	63	60	62	61	56	57	55	52	52	53	45
4																									
5	88	59	63	68	69	79	85	83	75	70	68	68	64	64	62	58	60	60	55	56	54	51	49	50	37
6	83	59	62	63	63	73	79	78	71	65	65	65	61	60	59	56	56	56	52	52	49	46	42	44	37

RUN NUMBER 26

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	96	71	71	75	76	81	84	86	89	87	87	85	82	81	80	82	84	84	75	74	71	70	70	71	67
2	101	78	79	83	84	86	87	88	92	91	91	89	87	87	87	90	92	93	85	83	80	77	74	75	70
3	96	69	70	75	77	81	83	85	89	88	87	85	82	80	78	81	83	82	73	72	71	69	68	69	62
4																									
5	96	68	71	75	75	80	84	87	91	88	86	84	81	79	77	80	82	82	74	72	70	68	67	67	58
6	91	63	64	69	69	74	79	82	86	83	82	80	76	75	73	76	78	78	69	67	65	63	60	60	56

RUN NUMBER 27

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	99	73	72	76	77	82	84	86	89	89	89	88	86	84	82	86	88	89	82	77	74	73	74	74	70
2	104	87	81	84	85	87	87	89	93	93	92	92	90	89	89	94	95	97	92	85	83	80	77	78	72
3	98	72	72	76	79	83	84	86	89	90	89	89	86	83	81	85	87	87	80	76	75	72	72	73	66
4																									
5	98	74	73	77	77	81	85	87	90	90	89	88	85	82	80	83	87	86	80	75	73	71	71	70	62
6	94	71	67	71	71	76	79	82	86	85	85	84	80	78	76	79	82	82	76	71	69	66	64	64	61

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 28

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	103	75	75	79	80	83	85	86	89	90	91	92	90	90	87	93	95	96	94	83	79	77	78	79	74
2	110	92	93	87	86	88	88	89	93	93	93	94	93	93	92	101	102	103	103	95	87	83	81	82	75
3	102	73	74	78	80	83	84	85	89	90	91	91	90	89	86	92	94	94	91	82	78	76	76	77	69
4																									
5	102	75	78	80	80	83	85	86	90	91	91	92	91	89	85	89	96	94	92	81	77	75	75	75	65
6	97	71	72	73	74	78	80	81	85	85	87	87	85	84	82	86	90	89	87	76	72	70	68	68	64

RUN NUMBER 29

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	104	75	80	79	80	83	85	86	89	90	91	92	91	91	89	95	97	97	96	89	80	79	80	81	76
2	112	90	96	88	89	89	88	89	93	94	94	95	94	94	93	103	104	105	105	101	89	86	83	84	79
3	104	78	84	78	80	83	84	85	89	90	91	92	91	90	87	93	96	96	93	87	80	78	78	79	72
4																									
5	104	74	79	78	79	82	85	86	90	91	92	93	92	90	87	91	98	97	94	87	79	77	77	76	68
6	99	73	78	73	73	77	79	81	85	85	87	88	86	86	83	87	92	92	89	82	74	72	69	70	66

RUN NUMBER 30

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	106	75	81	80	81	83	84	85	89	90	91	93	92	93	91	96	98	99	97	92	82	81	81	83	79
2	113	85	98	91	93	89	87	89	93	93	94	95	95	95	95	103	105	106	105	103	91	87	85	86	81
3	104	75	86	82	83	84	84	85	88	90	92	93	92	92	90	94	97	97	94	90	82	80	80	81	74
4																									
5	105	74	81	81	81	83	85	86	90	91	92	94	93	92	89	92	99	99	94	90	81	79	79	79	71
6	100	69	77	75	76	77	79	81	85	86	88	89	88	88	86	88	93	93	90	85	76	74	71	72	69

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 31

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	85	64	66	69	71	76	78	78	78	75	73	71	69	68	65	62	61	60	57	57	54	53	53	54	50
2	83	63	66	70	72	75	75	74	75	75	71	68	64	64	62	58	56	54	50	49	45	40	36	40	28
3	85	62	65	70	72	76	78	78	78	75	73	71	68	67	64	60	60	59	56	55	53	50	50	52	44
4																									
5	86	62	65	71	72	77	80	80	79	75	72	70	67	66	63	60	59	59	56	55	53	51	50	49	41
6	81	58	61	64	65	71	74	74	74	70	68	66	62	61	59	56	55	55	51	50	48	46	43	44	40

RUN NUMBER 32

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	93	66	68	72	73	78	80	81	84	85	86	85	82	80	77	74	74	73	71	69	67	66	67	68	64
2	90	66	69	72	74	77	77	77	81	85	83	81	77	75	73	70	69	67	63	62	57	52	49	51	37
3	93	65	68	73	75	79	80	81	85	86	86	85	82	79	75	73	73	72	69	67	66	64	64	66	59
4																									
5	93	64	68	72	73	78	80	82	86	86	86	85	81	78	75	72	72	72	69	68	66	65	64	63	54
6	88	60	62	67	67	72	76	77	80	80	81	80	76	73	71	69	68	67	64	63	62	59	57	58	55

RUN NUMBER 33

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	95	70	67	72	73	78	80	81	84	86	87	87	85	83	80	77	77	76	74	73	71	69	70	71	68
2	92	71	70	73	75	77	77	77	82	85	84	83	81	78	76	73	72	70	66	65	61	57	54	56	45
3	94	71	69	73	75	79	80	81	85	86	87	87	85	83	79	75	75	75	72	70	69	67	68	70	63
4																									
5	95	70	68	73	74	78	80	82	86	87	88	88	85	82	78	75	75	75	72	71	70	68	68	67	59
6	90	66	62	67	68	72	75	76	80	81	82	82	79	77	74	71	71	70	68	66	65	63	61	62	59

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 34

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	97	68	68	73	72	76	78	79	83	85	87	89	89	88	86	83	82	82	80	79	77	76	77	78	74
2	93	76	76	72	73	76	75	75	80	85	85	86	84	84	83	79	77	76	73	71	67	63	61	62	53
3	96	66	67	73	74	77	79	79	83	85	87	89	89	88	85	81	81	81	78	76	75	73	74	76	69
4																									
5	98	74	74	73	73	77	79	80	85	87	89	91	90	88	85	81	81	81	79	78	76	75	75	74	67
6	92	68	68	68	67	71	74	75	79	81	83	85	84	83	81	77	77	76	74	72	71	69	67	68	66

RUN NUMBER 35

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	71	77	74	74	76	78	79	83	85	88	90	90	90	88	85	84	84	82	81	79	78	79	80	77
2	94	70	75	73	74	76	75	75	80	85	85	86	86	86	85	82	80	78	76	73	69	65	63	64	57
3	98	73	79	74	74	77	78	79	83	86	88	90	90	90	87	84	83	83	80	78	77	75	76	78	72
4																									
5	99	70	75	73	73	77	79	80	85	87	89	92	91	90	87	84	83	83	81	80	78	77	77	76	70
6	93	70	76	67	66	71	74	75	79	81	84	86	85	85	83	80	79	78	76	74	73	71	69	71	68

RUN NUMBER 36

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	71	71	75	75	79	81	81	85	86	89	90	90	89	86	83	83	82	80	79	77	76	76	78	74
2	94	76	76	75	76	79	78	78	82	86	86	86	85	85	83	80	78	76	74	72	68	64	62	63	54
3	97	68	69	76	77	81	81	82	85	87	88	90	89	88	85	82	81	81	78	76	75	73	74	76	70
4																									
5	98	74	75	75	75	79	81	82	86	87	89	91	90	89	85	82	81	81	79	78	76	74	75	74	66
6	93	67	68	69	69	74	76	77	81	82	84	86	84	83	81	77	77	76	74	72	71	69	67	68	66

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 37

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	99	73	78	79	79	82	83	84	86	88	90	91	91	91	89	86	85	84	82	81	79	78	79	80	76
2	96	72	76	78	79	82	81	79	84	87	87	88	86	86	85	82	80	79	76	74	70	65	63	64	55
3	99	78	85	77	79	83	84	84	87	88	90	91	91	90	88	84	83	83	80	78	77	76	76	79	72
4																									
5	100	71	76	76	77	81	83	84	87	89	90	92	92	91	87	84	83	83	81	80	78	76	77	76	69
6	95	72	79	71	71	76	78	79	82	83	86	87	86	86	83	80	79	78	76	74	73	71	69	70	68

RUN NUMBER 38

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	64	66	67	69	77	82	81	74	70	70	68	66	66	64	62	62	61	58	58	55	53	53	54	48
2	86	78	77	75	74	77	79	77	71	70	67	66	63	63	62	59	58	57	51	52	47	43	40	43	39
3	86	65	64	67	69	77	82	81	75	70	69	69	66	65	64	60	61	61	57	57	54	52	52	54	47
4																									
5	88	59	63	68	70	78	84	83	75	69	68	68	64	64	62	59	59	60	55	56	54	52	50	49	36
6	82	57	61	62	63	72	79	77	70	64	64	64	60	60	59	56	56	56	52	52	49	47	43	45	39

RUN NUMBER 39

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	96	70	71	74	76	81	84	86	89	88	87	85	82	81	79	77	77	77	74	73	71	70	70	71	67
2	93	78	77	78	78	81	80	82	86	87	84	82	78	76	75	73	72	71	68	66	62	57	54	56	43
3	96	69	70	75	77	81	83	86	89	88	87	85	82	80	78	75	76	75	72	71	69	67	68	70	62
4																									
5	96	68	71	74	75	80	84	87	90	88	87	85	81	79	77	74	74	75	72	72	70	68	67	66	57
6	91	63	65	69	70	74	79	82	85	83	82	80	76	75	73	71	70	70	68	67	65	63	60	61	59

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 40

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	74	73	77	78	82	85	86	89	89	90	89	86	85	82	80	79	79	77	76	74	73	73	74	70
2	95	80	78	79	79	82	82	82	86	89	87	85	81	80	79	76	75	73	70	69	65	60	57	58	41
3	98	73	72	77	79	83	84	86	89	90	89	89	86	84	81	78	78	78	76	74	73	71	71	73	66
4																									
5	98	75	73	77	77	81	85	87	91	90	90	89	85	83	80	77	77	78	76	75	73	71	71	70	62
6	93	71	67	71	71	76	80	82	85	85	85	84	80	78	76	73	73	73	71	70	68	66	64	65	61

RUN NUMBER 41

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	99	73	74	78	79	83	85	86	89	90	91	91	90	89	87	84	83	83	81	80	78	77	78	79	75
2	97	81	81	81	81	83	82	82	86	89	88	88	85	85	84	80	79	77	75	73	69	65	63	64	56
3	99	72	74	78	80	83	84	86	89	90	91	91	90	89	86	83	82	82	79	78	77	75	76	78	72
4																									
5	100	75	78	79	79	83	85	87	90	91	91	92	90	89	85	82	81	81	80	79	77	76	76	75	68
6	95	70	72	72	73	77	80	82	85	85	87	87	85	84	81	78	77	77	75	74	72	70	68	70	67

RUN NUMBER 42

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	101	75	79	80	80	84	85	86	89	90	91	92	91	91	89	86	85	85	83	82	80	79	80	81	77
2	97	80	81	81	81	82	82	82	86	89	89	89	87	87	86	82	81	79	77	75	71	67	65	66	58
3	100	78	84	79	80	83	85	86	89	90	91	92	91	91	88	85	84	84	81	80	79	77	78	80	74
4																									
5	101	73	79	79	80	83	85	87	90	91	92	93	92	91	87	84	83	83	82	81	79	78	78	77	71
6	96	72	78	72	73	77	80	82	85	86	87	88	86	86	84	80	79	79	77	75	74	72	70	72	70

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 43

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	65	66	69	71	76	78	78	78	75	73	72	69	68	65	62	61	60	56	56	54	52	52	54	48
2	89	70	71	74	76	78	78	79	81	80	78	77	74	74	72	69	68	66	64	64	61	57	56	58	50
3	86	63	65	71	72	76	78	78	78	75	73	71	68	67	64	60	60	59	54	54	53	50	49	52	43
4																									
5	86	62	66	71	72	77	80	80	79	75	73	71	67	66	64	59	59	59	54	55	53	51	49	49	37
6	81	59	61	64	66	71	75	74	73	70	68	66	62	62	60	56	55	55	51	50	49	46	42	45	40

RUN NUMBER 44

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	93	67	68	72	73	78	80	81	84	85	86	85	82	79	76	74	73	73	70	69	67	65	66	67	63
2	97	75	77	80	81	83	83	84	88	88	89	88	86	84	82	80	80	79	77	76	73	70	68	69	65
3	93	65	69	73	75	79	80	81	84	85	85	85	81	78	75	72	72	72	68	66	65	63	63	65	58
4																									
5	93	64	69	73	73	78	81	82	85	86	86	85	81	78	75	72	71	71	68	68	66	64	64	63	54
6	88	61	65	67	67	72	75	77	80	80	81	80	76	73	70	68	67	67	64	63	61	59	56	58	54

RUN NUMBER 45

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	94	70	68	73	74	78	80	81	84	86	87	87	85	83	79	76	76	76	73	72	70	69	69	70	67
2	98	85	77	80	81	83	82	84	88	89	89	90	88	87	85	83	83	82	80	79	77	74	72	73	69
3	94	71	69	73	75	79	80	80	84	86	86	87	85	82	78	75	75	75	72	70	69	67	67	69	62
4																									
5	95	70	70	74	74	79	81	82	85	87	87	87	85	82	78	74	74	74	72	71	69	68	67	66	59
6	89	66	64	68	68	72	76	77	80	81	82	82	79	77	73	70	70	70	67	66	64	62	60	61	58

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 46

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	97	68	68	73	73	77	78	79	83	85	87	89	89	89	86	83	82	82	80	78	76	75	76	77	74
2	102	92	93	83	82	81	81	83	87	88	90	91	91	91	90	89	88	87	86	85	82	80	78	79	76
3	96	65	67	73	74	77	78	79	83	85	87	89	89	88	85	82	80	80	78	76	75	73	74	76	69
4																									
5	97	73	74	73	73	77	79	80	85	86	89	90	90	88	85	81	80	80	78	77	76	74	74	74	66
6	92	69	70	68	67	71	74	75	79	81	83	85	84	83	81	77	76	76	73	72	71	69	67	68	66

RUN NUMBER 47

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	72	78	74	73	76	78	79	83	85	88	90	90	90	88	85	84	84	82	80	79	77	78	80	76
2	103	88	95	86	85	81	80	82	87	88	90	92	92	93	92	90	90	89	87	86	84	81	80	81	76
3	98	72	78	73	74	77	78	79	83	85	88	90	90	90	87	84	82	82	80	78	77	75	76	78	71
4																									
5	99	69	74	72	73	77	79	80	85	87	89	91	91	90	87	84	82	82	80	79	78	76	76	76	69
6	93	71	76	67	66	71	74	75	79	81	84	86	85	85	83	80	78	78	76	74	73	71	69	70	68

RUN NUMBER 48

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	97	69	69	74	73	77	79	80	84	86	88	89	89	89	86	83	82	82	80	78	77	76	76	77	74
2	102	92	93	84	82	83	82	84	88	89	90	92	92	91	90	89	88	87	86	85	82	80	78	79	76
3	97	66	67	74	75	78	79	80	84	86	88	89	89	88	86	82	80	80	78	76	75	73	74	76	69
4																									
5	98	74	75	73	74	78	79	81	85	87	89	91	90	89	85	82	80	80	78	77	76	74	74	74	66
6	92	68	68	68	68	72	75	76	80	81	84	85	84	83	81	78	76	76	73	72	71	69	67	68	66

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 49

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	72	78	74	74	76	78	79	83	85	88	90	90	90	89	86	84	84	82	80	79	78	78	80	76
2	103	88	95	86	86	82	80	82	87	88	90	92	92	93	92	90	89	89	87	86	84	81	80	83	76
3	98	73	78	73	74	77	78	79	83	85	88	90	90	90	87	84	83	82	80	78	77	75	76	78	71
4																									
5	99	70	74	72	73	77	79	80	85	87	89	91	91	91	87	84	83	82	80	79	78	77	77	76	69
6	93	71	76	66	66	72	74	75	79	81	84	86	85	85	83	80	78	78	76	74	73	71	69	71	68

RUN NUMBER 50

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	65	66	66	68	77	82	81	75	70	70	69	66	66	65	62	62	62	58	58	55	54	54	55	49
2	87	67	67	69	70	77	80	80	76	75	75	74	72	72	71	70	70	70	68	67	64	60	58	58	53
3	86	63	62	67	69	77	82	82	76	70	69	69	66	65	64	60	61	61	57	57	54	52	52	54	47
4																									
5	88	58	63	67	70	78	85	84	75	69	68	69	66	64	62	59	59	60	56	57	54	52	50	49	37
6	83	57	59	61	63	72	79	78	70	65	64	64	60	60	59	55	55	56	52	52	50	47	44	45	40

RUN NUMBER 51

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	96	71	71	75	76	81	84	86	89	88	87	85	82	81	79	77	76	76	74	73	71	69	69	70	66
2	100	78	80	83	85	87	87	89	93	92	91	90	88	87	86	85	85	84	83	82	79	76	73	74	69
3	96	69	70	75	78	82	83	86	89	89	87	85	82	80	78	75	76	75	72	71	70	67	68	70	62
4																									
5	96	68	71	75	76	80	84	87	90	89	87	85	81	79	77	74	74	75	72	72	70	68	67	66	57
6	91	63	65	69	70	75	79	81	85	83	82	80	76	75	73	70	70	70	68	67	65	63	60	61	58

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 52

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	74	72	77	78	82	85	86	89	89	89	89	86	85	82	80	79	79	77	76	74	73	73	74	70
2	102	87	81	84	85	87	88	90	93	93	93	92	90	90	88	88	87	87	86	85	82	79	76	77	74
3	97	73	72	77	79	83	84	86	89	90	89	89	86	84	81	78	78	78	76	74	73	71	72	74	66
4																									
5	98	75	74	77	78	82	85	87	90	90	90	89	85	83	80	77	77	77	76	75	73	71	71	70	62
6	92	71	66	71	71	76	80	82	85	84	85	84	80	78	76	73	73	73	71	70	68	66	64	65	62

RUN NUMBER 53

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	100	73	74	79	79	83	85	86	89	90	91	91	90	90	88	85	83	83	81	80	78	77	77	79	75
2	104	93	94	87	87	88	88	90	93	94	93	94	93	93	92	91	91	90	89	88	85	82	82	85	77
3	99	71	74	79	80	83	84	86	89	90	91	91	90	89	86	83	82	82	79	78	77	75	76	78	71
4																									
5	100	76	78	79	79	83	85	87	90	91	91	92	91	89	86	82	81	81	79	78	77	76	75	75	68
6	95	70	71	72	73	77	80	82	85	85	86	87	85	84	82	78	77	76	74	73	72	70	68	69	66

RUN NUMBER 54

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	100	75	80	80	80	83	85	86	89	90	91	92	91	91	89	86	85	85	82	82	80	79	80	81	77
2	105	90	97	88	88	88	88	89	93	93	94	95	94	94	93	92	92	92	91	90	87	84	82	84	80
3	100	78	84	78	80	83	84	85	89	90	91	92	91	90	88	85	84	83	81	79	79	77	78	80	73
4																									
5	100	73	79	78	79	82	84	86	90	91	92	93	92	91	87	84	83	83	81	80	79	77	77	76	69
6	95	73	79	72	72	76	79	81	84	85	87	88	86	85	83	80	79	78	76	75	74	72	70	71	69

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 55

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	83	61	62	66	67	72	74	75	77	74	71	68	65	65	62	59	58	57	54	54	51	50	50	52	47
2	85	65	66	68	70	72	73	75	78	76	74	73	71	70	69	66	65	64	61	61	58	55	53	54	50
3	83	59	61	67	68	72	74	75	77	74	70	68	65	64	61	58	57	56	52	53	50	48	47	50	42
4																									
5	84	60	63	68	68	73	75	77	78	74	70	67	64	63	61	57	56	55	51	53	50	49	47	46	36
6	78	57	59	62	61	66	70	71	73	69	65	62	59	58	57	53	52	51	48	48	45	43	40	41	37

RUN NUMBER 56

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	89	64	65	68	69	73	75	76	80	81	82	82	79	77	73	71	71	71	68	67	65	64	65	66	63
2	92	71	71	72	73	74	75	77	81	82	83	83	81	80	78	78	78	77	76	74	72	69	67	68	65
3	89	62	64	69	70	74	76	77	80	81	82	82	79	76	72	69	69	69	67	65	64	62	62	64	58
4																									
5	90	63	66	70	70	74	76	78	81	83	84	83	79	75	71	69	69	69	67	66	64	63	63	62	54
6	85	60	62	64	64	68	71	73	76	77	78	78	74	71	67	65	65	65	62	61	60	58	56	57	55

RUN NUMBER 57

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	92	68	65	70	71	75	76	77	81	83	84	85	83	81	78	75	75	75	72	72	70	69	69	71	67
2	95	84	73	74	74	75	76	77	82	84	85	86	85	84	82	81	81	81	79	78	76	73	71	72	70
3	92	68	65	71	72	75	76	77	81	83	84	85	83	81	76	73	73	73	70	69	68	66	67	69	62
4																									
5	93	69	67	72	73	76	77	79	83	84	86	86	84	80	76	73	73	73	71	70	69	67	67	66	59
6	87	65	61	65	65	69	72	73	77	78	80	81	78	75	72	68	68	68	66	65	64	61	59	61	58

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 58

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	89	64	65	68	69	74	75	76	80	81	82	82	79	76	72	71	71	70	68	67	65	64	65	66	62
2	92	69	71	72	74	76	75	77	81	82	83	83	81	80	79	78	79	78	76	75	72	69	68	69	66
3	89	61	63	69	71	75	76	77	80	81	82	82	79	76	72	69	69	69	67	65	64	62	62	64	58
4																									
5	90	63	66	70	71	74	77	78	81	83	83	83	79	75	71	69	69	69	67	66	64	63	62	62	54
6	85	58	61	64	64	70	71	72	76	77	78	77	73	70	66	65	65	64	62	61	59	57	55	56	54

RUN NUMBER 59

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	92	69	66	70	71	75	76	77	81	83	84	85	82	80	77	74	75	75	72	71	69	68	69	70	66
2	95	84	74	75	75	78	77	78	82	84	85	86	85	84	82	82	83	82	81	80	77	74	72	73	70
3	92	71	65	70	72	76	77	78	81	83	84	85	83	80	76	73	73	73	70	69	68	66	67	69	61
4																									
5	93	70	67	71	72	75	77	79	83	84	85	86	83	80	76	72	73	73	71	70	68	67	67	66	58
6	87	63	62	65	65	69	72	73	77	78	80	80	77	75	71	68	68	68	66	65	63	61	59	60	58

RUN NUMBER 60

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	90	68	69	70	71	76	77	76	81	82	83	82	79	77	74	72	72	72	70	70	68	66	67	68	64
2	93	71	72	73	74	77	76	77	82	83	84	84	82	82	81	80	81	80	79	78	75	72	70	71	68
3	90	65	65	70	71	76	77	76	80	82	83	82	80	77	74	71	71	72	69	68	67	65	65	67	60
4																									
5	91	64	67	72	72	77	78	78	82	83	84	82	78	75	72	70	70	71	68	68	66	64	64	63	54
6	85	60	62	66	65	71	73	72	76	78	78	77	73	70	68	66	66	66	64	63	62	59	57	58	55

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 61

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	90	70	66	69	70	75	77	77	79	80	82	82	81	80	77	74	74	74	73	72	70	69	70	71	68
2	94	84	73	74	74	77	77	77	80	82	83	84	83	83	82	82	82	82	81	81	78	75	73	74	72
3	90	69	65	69	70	75	78	77	79	81	82	83	82	80	76	73	73	73	71	70	69	67	68	70	63
4																									
5	91	70	66	71	71	76	79	79	80	82	83	83	82	79	75	71	72	72	71	71	69	67	67	67	59
6	86	66	60	65	65	70	74	73	75	76	77	78	76	74	71	67	68	68	66	66	64	62	60	62	59

RUN NUMBER 62

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	65	66	69	71	76	78	78	78	75	73	71	69	68	66	63	62	62	59	59	56	55	55	55	49
2	89	70	71	74	75	77	78	79	81	80	79	77	75	74	73	71	70	69	67	67	64	60	57	57	51
3	85	63	65	70	72	76	78	78	78	75	73	71	68	67	65	61	61	60	56	56	54	51	50	51	42
4																									
5	86	62	66	71	72	77	79	80	79	75	72	70	67	66	64	60	60	59	55	56	54	52	50	48	34
6	81	59	61	65	65	71	75	74	74	70	68	66	62	62	60	56	56	56	52	52	50	48	44	45	40

RUN NUMBER 63

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	93	68	69	72	73	78	80	81	84	85	86	85	82	80	78	76	76	75	73	72	69	68	68	69	65
2	97	75	76	80	81	83	83	85	88	89	89	88	86	85	84	83	83	82	80	79	76	72	70	71	68
3	93	66	69	73	75	79	80	81	84	85	86	85	82	79	76	74	74	74	71	69	67	65	65	67	59
4																									
5	94	64	68	73	73	78	80	82	85	86	86	85	81	78	76	74	74	73	71	70	68	66	65	65	56
6	88	62	64	68	68	72	76	77	80	80	81	80	76	74	71	69	69	69	66	64	63	61	58	59	56

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 64

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	95	71	69	72	73	78	80	81	84	86	87	87	85	83	80	78	79	79	77	75	72	71	71	72	69
2	99	85	77	80	81	83	83	84	89	89	90	90	89	88	86	85	86	86	84	82	79	75	73	75	71
3	94	71	69	73	75	79	80	81	84	86	87	87	85	83	79	77	77	77	75	72	70	68	69	71	64
4																									
5	95	72	69	73	74	78	80	82	85	87	88	88	85	82	79	76	77	77	74	73	71	69	69	68	61
6	90	67	64	67	67	72	75	76	80	81	82	82	79	77	74	72	72	72	70	68	66	64	61	62	60

RUN NUMBER 65

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	69	69	73	72	76	78	79	84	85	88	89	89	89	87	84	84	84	83	81	79	77	78	79	76
2	103	92	94	85	83	82	81	83	88	89	90	92	92	92	91	91	91	91	90	88	85	81	80	81	78
3	97	67	68	74	74	77	78	79	83	85	87	89	89	88	86	83	82	83	80	78	76	74	75	77	70
4																									
5	98	73	74	74	73	77	79	80	85	87	89	90	90	89	85	82	82	82	81	79	77	76	75	75	67
6	92	70	71	67	67	71	74	75	79	81	83	85	84	83	81	78	78	78	76	74	72	70	68	69	67

RUN NUMBER 66

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	99	73	79	76	76	76	78	79	84	86	88	90	90	90	89	87	86	86	85	83	81	79	80	81	78
2	104	89	96	87	87	82	81	83	87	89	90	93	93	94	93	92	92	92	91	89	86	83	81	82	79
3	98	75	81	74	75	77	78	79	84	86	88	90	90	90	88	85	84	85	82	80	78	76	77	79	73
4																									
5	99	70	76	72	73	76	79	80	84	87	89	91	91	90	87	85	84	84	83	81	79	78	78	77	70
6	94	72	78	67	67	71	74	75	79	81	84	86	85	85	83	81	80	80	78	76	74	72	70	71	69

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 67

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	70	70	75	74	78	79	80	84	86	88	90	89	89	87	84	84	85	83	81	79	77	78	79	76
2	103	93	94	86	84	84	83	84	89	90	91	92	92	93	92	91	91	91	90	88	85	82	80	81	79
3	97	67	68	75	76	79	80	81	84	86	88	89	89	88	86	83	82	83	80	78	77	75	75	77	70
4																									
5	98	75	75	74	74	78	80	81	85	87	89	91	90	89	85	83	82	83	81	79	77	76	75	75	68
6	93	68	68	69	68	73	75	76	80	81	84	85	84	83	81	78	78	78	76	74	72	70	68	69	67

RUN NUMBER 68

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	99	73	79	76	76	77	78	79	84	86	88	90	90	90	89	87	86	86	85	83	81	80	80	81	78
2	104	89	96	87	87	83	81	83	88	89	90	93	93	94	93	92	92	92	91	90	86	83	81	82	79
3	98	74	80	74	75	77	79	79	84	86	88	90	90	90	88	85	84	85	83	80	79	77	77	79	73
4																									
5	99	70	76	73	73	77	79	80	85	87	89	91	91	90	88	85	84	85	83	82	80	78	78	77	70
6	94	72	78	67	67	72	74	75	79	81	84	86	85	85	83	81	80	80	78	76	75	72	70	72	69

RUN NUMBER 69

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	67	69	66	69	77	82	81	74	70	70	69	67	66	65	62	62	63	60	59	57	56	56	57	50
2	87	68	68	69	71	78	80	79	76	75	75	74	72	72	72	71	71	71	70	69	66	62	60	60	54
3	86	63	62	68	69	76	82	82	75	70	69	69	66	65	64	61	62	62	58	58	55	54	54	55	46
4																									
5	88	60	63	68	70	78	85	83	75	69	68	68	64	64	62	59	60	60	57	58	55	54	53	50	35
6	83	60	62	62	63	72	79	78	70	65	64	64	60	60	59	56	56	56	53	53	51	50	47	46	40

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 70

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	96	70	71	75	76	81	84	86	89	88	87	85	82	81	79	77	77	77	75	74	71	70	70	72	67
2	100	78	79	83	84	86	87	89	92	92	91	90	88	87	86	85	86	85	84	83	80	76	73	75	71
3	96	69	71	76	78	82	84	86	89	88	87	85	82	80	78	76	76	76	73	72	70	68	69	71	63
4																									
5	96	68	71	75	76	80	84	87	90	88	87	85	81	79	77	74	75	75	73	72	70	68	68	67	58
6	91	63	65	69	70	74	79	81	85	83	82	80	76	75	73	70	71	71	68	67	65	63	60	62	58

RUN NUMBER 71

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	98	74	72	76	78	82	85	86	89	89	89	89	86	85	83	80	80	80	78	77	75	74	74	75	71
2	103	88	81	84	85	88	88	90	94	93	93	92	91	90	89	89	89	89	88	86	83	80	77	78	76
3	98	74	72	76	79	83	84	86	89	90	89	89	86	84	81	79	79	79	77	75	74	72	72	74	67
4																									
5	98	75	73	77	77	81	85	87	91	90	90	89	85	83	80	78	78	78	76	76	74	72	71	71	63
6	93	71	66	70	71	75	80	82	85	85	85	84	80	78	76	74	74	74	72	71	69	67	64	65	63

RUN NUMBER 72

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	100	73	74	78	79	83	85	86	89	90	91	91	90	89	87	85	84	85	83	82	80	78	79	80	76
2	105	93	94	88	87	88	88	90	93	93	93	94	93	93	92	92	92	93	92	90	87	84	81	82	79
3	99	71	73	78	80	83	84	86	89	90	91	91	90	89	86	84	83	83	81	80	78	76	77	79	72
4																									
5	100	76	78	78	79	82	85	87	90	91	91	91	90	89	86	83	82	83	81	80	78	76	76	76	69
6	94	70	71	72	72	77	80	81	85	85	86	86	84	84	81	79	78	78	76	75	73	71	69	70	68

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 73

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	101	75	79	78	79	83	85	86	89	90	91	92	91	91	89	87	86	86	85	84	81	80	80	82	78
2	106	90	96	89	89	88	88	90	93	93	93	94	94	94	93	93	94	94	93	92	89	85	83	84	81
3	100	75	80	78	79	83	84	85	89	90	91	92	91	90	88	85	85	85	83	81	80	78	78	80	73
4																									
5	100	74	79	78	79	82	85	86	90	91	92	93	92	90	87	85	84	84	83	82	80	78	78	78	71
6	95	71	77	72	73	76	79	81	84	85	87	87	86	85	83	81	80	80	78	77	75	73	71	72	70

RUN NUMBER

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3																									
4																									
5																									
6																									

RUN NUMBER

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3																									
4																									
5																									
6																									

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 74

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	54	47	48	43	42	42	35	38	43	40	39	39	33	29	30	22	24	21	18	20	12	7	5	10	7
8	53	45	45	42	45	46	38	39	44	40	39	37	30	29	32	24	24	22	19	15	10	3	-0	4	20
9	54	46	47	45	44	44	39	38	43	40	39	38	35	31	30	24	28	26	20	21	14	7	3	7	43
10	54	46	46	45	45	44	40	39	44	41	40	40	35	31	30	23	25	25	19	17	12	5	5	11	14
11	57	48	48	49	51	51	44	41	44	37	33	33	29	27	27	19	23	23	18	18	18	13	8	13	
12	54	46	46	45	46	47	41	39	43	40	39	39	34	30	30	24	25	25	20	20	16	7	5	12	13
13	54	46	45	44	46	47	41	39	43	39	39	39	35	32	30	24	25	26	20	20	13	5	5	11	6
14	53	45	44	43	45	47	37	37	43	40	39	38	33	31	29	25	25	26	22	23	18	11	9	15	11
15	54	46	46	44	46	47	41	38	43	40	39	38	33	31	29	26	27	26	20	20	18	14	11	15	8
16	54	46	45	44	45	46	43	40	43	40	39	38	34	31	31	26	27	27	22	22	18	12	11	17	10
17	54	46	47	44	45	45	40	38	44	41	39	38	34	31	30	27	28	26	20	21	18	12	11	16	9
18	55	47	50	44	45	46	42	40	43	40	39	39	35	33	31	27	28	27	24	23	21	17	16	17	11

RUN NUMBER 75

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	74	57	59	61	62	64	66	66	67	65	60	57	54	52	50	46	48	46	40	40	41	39	38	38	29
8	72	55	57	60	60	63	63	63	64	62	60	58	55	53	51	46	48	47	42	42	39	38	32	28	22
9	72	56	57	60	61	63	63	63	64	62	60	58	55	53	51	44	45	47	43	39	41	36	32	28	20
10	84	60	62	65	67	73	77	78	77	74	70	66	62	61	58	52	53	54	49	45	49	46	44	39	67
11	87	65	68	73	74	76	81	81	79	76	70	67	64	63	63	58	59	59	55	57	57	55	53	49	41
12	84	61	63	66	68	74	77	77	78	74	70	67	63	62	59	55	56	56	51	50	51	48	43	40	39
13	82	60	62	65	67	72	75	75	76	73	70	67	63	62	59	54	55	56	50	51	50	45	42	42	39
14	79	59	61	64	65	68	70	70	72	71	68	65	62	61	59	56	56	56	50	53	52	49	46	47	45
15	77	60	61	65	65	67	67	66	69	69	68	66	63	62	60	57	57	55	52	52	51	49	48	47	42
16	80	61	62	66	67	70	72	72	72	71	70	68	65	63	61	59	59	58	55	55	53	50	48	48	42
17	82	61	62	65	67	72	75	74	75	73	70	67	63	63	60	56	56	56	53	51	51	51	51	52	50
18	84	60	62	65	67	74	77	77	77	73	70	67	63	62	59	54	55	55	50	50	50	47	45	45	39

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 76

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	82	59	61	63	64	65	67	69	74	76	75	74	69	64	61	58	59	58	53	53	54	51	51	52	45
8	80	58	61	63	64	66	65	66	70	72	73	72	69	65	61	59	60	59	56	55	52	51	48	46	38
9	80	58	60	64	65	65	65	66	71	73	73	72	69	65	61	57	58	59	57	52	53	50	47	41	35
10	91	63	65	68	70	75	79	81	83	85	84	82	77	72	68	65	66	67	64	61	62	59	59	57	46
11	93	69	72	76	76	79	82	83	86	86	86	84	80	75	73	71	72	72	70	70	70	69	67	65	60
12	91	64	66	69	71	76	79	81	84	84	84	82	78	74	70	67	68	68	65	64	64	61	57	57	54
13	89	63	66	68	70	74	77	78	81	82	82	81	77	74	69	67	68	68	64	63	63	59	57	55	50
14	86	62	65	68	69	72	73	74	78	78	78	76	74	71	68	67	68	68	62	65	64	61	58	59	57
15	84	62	65	69	70	72	72	72	76	76	76	74	72	71	69	68	69	67	64	64	62	60	60	59	54
16	87	63	66	70	71	74	75	76	78	79	79	78	75	73	71	70	71	70	67	66	64	62	60	60	54
17	89	64	66	69	71	74	77	77	80	82	82	81	77	74	71	68	68	68	66	64	62	61	59	59	54
18	90	63	65	68	70	75	79	80	82	83	83	82	77	74	69	67	67	67	63	64	62	60	58	58	52

RUN NUMBER 77

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	84	59	61	64	65	66	68	69	75	77	77	77	75	70	65	62	64	63	59	59	59	57	57	58	52
8	82	60	61	64	65	67	66	66	70	73	74	75	73	70	66	62	63	63	59	59	56	55	52	50	41
9	82	59	61	64	65	66	65	66	71	74	74	75	73	70	65	60	61	63	60	56	57	54	51	45	39
10	93	63	65	68	70	76	80	81	84	85	86	85	82	78	72	68	70	70	67	65	65	63	63	61	49
11	95	69	72	77	77	79	83	84	86	87	87	87	85	81	78	76	76	76	75	75	74	73	72	71	66
12	93	65	67	69	71	76	80	81	84	85	86	85	83	80	74	71	72	72	69	68	68	65	62	61	58
13	91	66	66	68	70	74	77	79	82	83	83	83	81	79	73	70	71	72	67	67	67	63	60	59	54
14	87	70	65	68	69	72	74	75	78	79	79	78	77	75	72	70	71	72	66	69	67	65	62	63	61
15	86	72	66	69	70	72	72	73	76	77	76	76	74	74	72	71	72	71	68	68	66	64	64	63	58
16	89	70	66	70	71	74	75	76	79	80	80	80	79	77	74	73	75	74	71	70	69	66	64	64	58
17	91	66	66	69	71	75	77	78	81	83	83	83	81	79	75	71	72	72	70	67	66	65	63	63	58
18	92	64	64	68	70	75	79	80	83	84	84	84	82	79	73	70	71	71	67	67	66	64	62	62	56

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 78

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	87	59	61	63	64	64	66	67	74	78	79	80	80	77	72	68	69	68	65	65	65	63	64	65	59
8	85	67	67	62	62	63	63	64	70	74	76	78	78	76	74	69	69	69	66	66	62	62	59	58	50
9	85	65	65	62	63	63	63	64	71	75	76	78	78	77	73	67	67	68	67	63	64	60	58	53	47
10	96	62	63	67	69	74	79	81	84	87	88	89	88	86	80	76	76	77	75	72	73	71	71	70	60
11	98	69	71	75	75	77	81	82	86	88	89	91	91	89	86	82	82	82	81	81	81	80	79	78	74
12	96	67	67	67	70	74	78	80	84	86	87	89	88	87	82	78	78	79	76	75	74	72	70	70	67
13	94	73	73	66	68	72	76	78	81	83	85	87	87	85	82	78	78	78	75	75	74	71	69	69	65
14	91	80	80	70	69	69	71	73	77	79	80	81	81	81	79	77	79	79	74	76	74	73	70	72	70
15	90	82	83	73	71	68	69	71	75	76	77	79	79	79	77	76	78	77	75	74	73	71	71	71	67
16	93	80	80	70	69	71	73	75	78	80	82	84	83	83	81	80	81	80	78	77	76	74	72	72	67
17	94	73	73	66	68	73	76	77	81	83	85	87	86	86	83	79	78	79	77	75	73	72	71	72	68
18	95	66	66	66	68	74	78	79	83	85	87	88	88	86	81	77	77	77	74	75	73	71	71	71	66

RUN NUMBER 79

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	89	57	60	62	63	65	66	67	74	78	80	82	83	81	75	71	72	71	68	68	68	66	67	68	63
8	87	62	70	62	62	63	63	64	70	75	76	79	80	79	76	72	72	72	69	69	66	65	62	62	54
9	87	62	70	62	63	63	63	65	71	75	77	80	80	80	77	71	70	72	70	66	67	64	62	58	53
10	97	62	67	65	68	73	78	80	84	87	89	91	91	89	84	78	78	79	77	75	75	74	74	73	63
11	101	69	74	75	75	77	81	82	86	88	90	93	94	92	89	85	85	85	84	85	84	83	82	81	77
12	98	62	67	66	68	74	78	79	84	86	88	90	91	90	85	81	80	81	78	78	77	75	73	73	70
13	96	71	78	66	67	71	76	77	81	84	86	88	89	88	85	81	80	81	77	77	77	73	72	71	67
14	93	77	85	73	74	68	71	72	77	79	81	83	83	83	82	80	81	82	77	79	78	76	74	75	74
15	92	79	87	77	77	68	67	68	74	75	77	79	79	80	78	76	78	77	75	74	74	73	72	73	68
16	95	77	85	74	75	70	73	74	78	80	83	85	85	85	84	82	83	83	80	80	78	77	75	75	71
17	96	70	77	67	69	72	75	76	81	84	86	88	88	89	86	82	81	81	80	78	76	75	74	75	71
18	97	64	69	66	68	73	78	79	83	85	88	90	90	89	85	80	80	79	77	77	76	74	74	74	69

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 80

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	58	50	51	49	50	49	43	41	48	45	42	40	34	34	32	20	25	26	21	13	13	7	8	13	19
8	58	49	50	50	49	48	44	42	49	46	42	40	34	34	32	22	25	27	22	15	13	7	4	8	22
9	58	50	51	50	50	49	45	42	50	47	42	42	36	34	32	23	24	28	21	15	14	8	4	6	
10	58	50	50	50	50	50	45	42	49	46	43	41	35	34	32	23	25	28	22	16	15	8	6	12	
11	62	53	54	54	52	52	51	46	49	44	37	35	28	29	28	15	22	23	19	-0	17	10	8	14	
12	59	50	52	51	50	48	44	42	48	46	42	40	35	34	32	23	24	28	23	9	18	12	8	14	11
13	58	50	51	50	49	48	45	42	47	45	42	41	37	34	31	24	26	29	24	20	18	11	7	12	13
14	59	50	52	50	50	50	44	41	47	45	42	41	35	34	31	22	24	29	24	21	19	12	10	17	15
15	58	49	50	50	50	48	43	41	49	46	42	41	35	35	31	25	26	28	23	15	20	15	11	17	41
16	59	50	51	50	50	49	46	44	50	47	43	41	37	35	32	25	27	29	26	20	20	14	11	19	15
17	58	49	50	50	50	49	43	41	49	47	43	41	36	35	32	26	27	28	24	17	20	13	12	19	29
18	58	49	49	50	49	49	44	42	48	46	43	41	37	36	33	27	27	30	27	21	22	16	13	20	14

RUN NUMBER

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7																									
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									
18																									

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 81

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	66	57	57	54	53	57	55	53	57	54	54	53	51	49	46	43	48	42	31	31	21	17	16	21	50
2	69	56	57	56	57	59	57	56	63	56	57	54	52	52	50	47	52	45	33	35	26	25	43	50	28
3	67	56	57	55	55	60	56	55	59	56	56	53	50	53	47	42	48	43	31	32	28	25	22	19	
4																									
5	66	55	57	53	54	60	54	54	57	54	54	53	51	51	46	43	47	41	30	32	26	21	12	19	16
6	64	51	52	52	52	55	53	52	56	51	52	51	48	49	45	41	47	42	30	30	20	22	22	26	28

RUN NUMBER 82

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	73	56	59	57	57	61	62	62	66	65	65	62	58	56	53	48	47	48	48	50	41	32	29	31	30
2	77	56	64	60	58	64	61	60	67	65	64	62	57	57	56	48	46	47	45	50	43	37	68	73	39
3	73	56	59	59	59	62	62	62	67	66	65	62	58	57	53	47	46	48	47	48	41	33	31	31	40
4																									
5	75	54	60	58	58	64	63	64	68	67	66	64	59	56	53	48	46	48	49	49	41	34	27	31	20
6	70	51	56	55	54	59	59	59	62	61	61	59	54	52	49	45	44	44	43	43	36	24	21	22	20

RUN NUMBER 83

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	82	62	57	59	59	63	66	67	73	75	75	75	72	70	67	62	59	57	53	55	56	59	55	48	38
2	84	75	77	66	63	64	63	64	72	74	75	75	71	70	68	61	59	57	50	58	56	57	67	73	48
3	82	59	58	61	61	65	66	67	73	75	76	75	72	71	67	61	58	58	54	54	55	56	50	45	41
4																									
5	84	61	58	61	61	66	69	71	75	77	78	77	73	70	67	62	59	57	53	56	59	58	52	44	32
6	78	56	53	56	56	60	62	65	70	70	72	71	67	65	62	56	54	53	48	49	52	51	44	37	30

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 84

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	85	74	59	62	62	66	68	70	75	77	78	78	76	74	71	67	64	62	58	58	58	60	62	58	44
2	93	92	79	78	70	64	63	66	74	76	77	78	75	74	72	67	65	62	54	59	57	58	65	70	47
3	86	74	64	64	64	67	68	70	75	77	78	79	76	75	72	65	63	61	55	56	56	58	58	52	46
4																									
5	87	78	63	63	63	68	70	73	77	79	80	80	77	75	71	67	64	62	58	58	60	61	59	54	37
6	82	74	57	57	57	61	64	66	71	72	74	74	71	69	66	62	59	57	52	52	53	54	52	45	37

RUN NUMBER 85

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	91	79	80	79	76	68	69	72	77	80	82	83	81	80	78	74	72	70	64	63	61	62	65	69	60
2	104	100	100	91	88	82	67	68	76	79	81	82	79	80	78	73	72	69	59	64	60	60	86	93	60
3	90	75	75	77	75	70	71	72	78	80	82	83	81	81	78	73	71	70	64	60	60	61	64	66	53
4																									
5	91	75	76	67	66	70	71	74	80	82	84	85	83	81	77	74	72	69	64	63	61	63	65	64	54
6	86	73	73	70	67	63	66	68	74	75	78	79	76	75	73	68	66	64	57	57	55	55	55	57	51

RUN NUMBER 86

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	68	57	57	59	58	58	57	55	60	55	54	51	50	53	47	43	47	42	29	30	18	15	15	18	58
2	71	61	65	62	61	61	59	57	59	56	55	54	53	55	49	48	51	46	35	34	27	22	7	16	29
3	68	57	61	60	58	59	58	55	56	55	53	52	54	49	46	43	48	42	29	33	27	27	24	24	38
4																									
5	67	55	57	58	57	59	57	54	57	54	53	52	49	49	45	41	47	42	26	30	13	8	7	7	52
6	66	54	57	57	57	58	56	53	54	53	53	51	48	48	45	41	49	43	31	31	21	16	16	16	31

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 87

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																					
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	72	54	57	57	57	59	61	61	66	64	64	61	57	57	53	48	47	48	47	49	47	48	48	42	35
2	73	55	59	59	59	62	61	60	65	64	64	62	58	58	57	51	50	50	49	51	49	49	45	42	38
3	72	55	58	60	58	60	62	61	65	65	63	61	58	55	53	47	46	47	44	48	47	48	45	39	39
4																									
5	74	53	58	60	59	62	63	64	67	66	66	63	58	55	52	48	47	48	46	49	47	49	45	38	25
6	69	51	55	56	55	58	58	58	62	61	60	58	53	51	48	45	44	44	42	43	42	42	39	29	21

RUN NUMBER 88

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																					
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	82	61	58	60	60	63	66	68	72	74	75	74	72	70	67	62	60	59	56	57	57	58	60	63	61
2	83	75	75	66	63	64	62	64	71	74	75	74	70	70	68	62	61	60	55	59	57	57	61	68	59
3	82	58	60	61	61	64	66	67	72	74	75	74	71	70	67	60	58	58	55	54	56	56	58	61	54
4																									
5	84	59	59	61	62	66	68	71	75	77	77	76	73	70	67	62	59	58	54	57	57	57	60	62	52
6	78	56	55	56	57	61	63	65	69	70	71	71	67	65	62	57	55	54	49	50	51	50	51	55	51

RUN NUMBER 89

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																					
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	85	71	58	63	62	65	68	69	74	76	77	78	75	74	71	66	64	62	58	59	58	59	62	65	63
2	92	91	77	77	68	64	64	65	73	76	77	77	74	74	72	67	65	64	59	62	60	60	65	72	62
3	85	68	62	63	64	66	67	69	74	76	77	77	75	73	71	65	63	62	57	58	58	58	60	63	58
4																									
5	87	78	62	63	64	68	70	72	77	79	80	79	77	74	71	67	64	62	58	59	59	60	61	64	57
6	81	70	55	57	58	61	64	66	71	72	74	74	70	68	66	62	60	58	54	53	53	53	53	58	56

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 90

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	90	75	76	79	76	68	70	72	77	79	81	82	81	80	78	74	72	70	65	64	63	63	66	70	67
2	103	99	100	90	87	79	69	70	76	79	81	82	80	80	79	75	74	71	66	68	66	65	63	67	67
3	90	80	81	73	71	68	70	71	77	79	81	82	80	79	77	73	71	69	64	63	62	62	64	67	62
4																									
5	91	66	66	68	67	71	72	74	79	81	83	84	82	80	77	74	72	69	65	65	63	63	65	66	63
6	86	75	76	66	65	63	66	68	73	75	77	79	76	74	72	69	67	65	59	58	57	56	56	60	60

RUN NUMBER 91

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	74	54	53	55	59	73	56	54	57	58	57	53	52	52	48	47	50	43	28	30	25	28	30	29	25
2	73	56	57	58	60	69	57	56	63	61	61	56	54	55	52	53	54	48	36	36	28	21	45	51	25
3	74	55	55	55	59	72	56	54	61	58	58	54	52	51	48	47	48	43	31	34	27	23	23	25	22
4																									
5	68	54	54	54	55	63	55	54	59	57	59	53	51	52	48	46	47	42	31	31	24	19	17	21	25
6	67	51	51	53	55	64	54	53	54	53	55	52	50	50	47	48	48	42	32	29	20	16	14	15	19

RUN NUMBER 92

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	76	64	59	61	63	74	59	56	61	59	58	57	53	54	52	48	46	47	46	50	48	43	43	37	30
2	76	66	60	63	63	73	60	58	65	61	61	60	54	56	57	50	50	48	44	53	48	38	59	65	42
3	74	65	58	65	64	70	58	56	63	60	58	58	54	56	53	46	46	46	43	49	47	40	38	33	28
4																									
5	71	61	56	59	58	64	57	56	62	58	60	57	54	53	51	48	46	47	47	49	46	42	39	31	27
6	69	59	54	59	59	63	55	53	57	55	55	55	51	54	50	46	44	43	40	43	41	35	30	23	24

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 93

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	75	63	59	59	60	72	59	59	62	60	61	59	53	56	55	52	53	55	53	55	56	58	58	50	39
2	82	77	77	67	65	74	60	60	65	60	66	63	52	59	59	47	55	56	49	57	56	55	67	73	52
3	74	62	61	60	62	70	58	59	62	59	63	61	52	55	55	49	52	53	49	53	55	56	53	46	37
4																									
5	73	63	62	60	61	66	58	59	61	59	61	61	53	55	55	51	52	54	52	54	56	57	55	46	36
6	69	59	55	55	55	64	55	55	58	54	58	57	49	51	50	46	48	49	47	48	50	51	47	37	30

RUN NUMBER 94

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	78	74	61	62	63	71	62	57	61	59	61	64	54	57	56	53	54	57	54	57	57	59	62	59	43
2	92	92	79	78	71	72	62	55	64	59	63	65	49	58	60	48	56	57	48	58	56	56	68	74	46
3	76	73	62	63	64	68	60	57	61	58	60	64	52	56	56	50	53	55	52	54	56	57	59	54	42
4																									
5	80	79	64	62	61	67	63	58	62	59	60	62	53	55	56	53	54	56	54	55	57	59	59	55	39
6	75	74	57	54	55	64	56	53	57	53	55	59	49	52	51	48	50	51	49	50	51	52	51	45	36

RUN NUMBER 95

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	80	81	79	76	69	64	64	64	63	62	63	61	59	60	58	60	61	60	61	61	62	65	68	62
2	105	100	101	93	90	81	71	66	68	62	63	66	56	61	65	56	60	60	54	59	58	58	89	94	63
3	83	71	71	80	77	70	65	64	65	63	62	63	56	58	61	55	57	60	55	58	59	60	62	66	55
4																									
5	85	81	81	72	69	69	66	63	65	62	61	64	59	59	59	56	58	60	59	59	60	60	64	62	56
6	78	73	73	71	68	63	59	58	60	56	56	59	51	54	54	48	52	54	51	53	53	54	54	55	51

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 96

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	73	60	60	55	59	72	56	54	57	59	58	53	52	52	49	47	48	43	34	32	23	17	7	33	
2	74	61	62	57	61	73	58	56	58	60	60	55	54	56	52	52	52	49	39	37	30	23	16	23	18
3	71	61	61	56	60	68	54	54	59	58	57	53	51	52	48	47	47	42	29	29	21	18	17	9	22
4																									
5	71	63	62	55	58	68	55	55	58	57	58	54	52	52	49	49	47	43	35	33	26	26	23	24	27
6	71	60	61	54	57	68	55	53	54	54	55	52	50	51	48	47	48	42	34	29	21	16	14	14	49

RUN NUMBER 97

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	73	57	53	59	59	70	56	56	60	59	59	57	51	52	51	48	45	47	45	49	53	57	50	40	52
2	74	54	54	63	63	72	59	57	61	58	59	58	51	56	55	49	48	49	46	53	54	55	45	41	41
3	73	55	56	65	64	68	57	55	61	59	58	56	51	54	52	46	43	46	43	48	54	56	48	37	31
4																									
5	71	53	54	59	60	66	55	55	60	57	57	57	51	54	51	48	46	48	46	49	55	58	48	38	33
6	69	51	51	55	58	67	53	53	56	54	55	53	48	49	47	46	44	43	40	42	48	50	39	26	59

RUN NUMBER 98

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	76	60	56	57	59	67	58	58	60	59	61	60	54	56	56	54	56	59	58	59	59	61	67	72	65
2	81	75	76	68	68	73	59	56	63	59	63	62	51	59	59	53	59	62	62	65	65	62	65	70	65
3	75	62	62	60	62	65	58	57	62	58	62	59	50	56	54	48	53	56	52	56	57	59	66	70	60
4																									
5	76	61	60	61	62	68	59	59	62	58	59	59	55	56	56	53	56	60	57	58	58	61	71	68	60
6	70	56	54	55	57	64	55	54	57	54	57	56	49	52	51	48	51	54	51	52	52	53	60	61	55

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 99

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	79	74	59	63	64	68	58	56	61	61	60	64	53	56	57	53	55	57	55	58	57	59	67	72	72
2	92	91	78	77	71	73	59	55	64	59	61	64	51	59	60	51	57	60	57	64	62	59	62	69	68
3	78	74	62	64	64	66	60	56	61	59	58	64	51	56	55	50	52	56	52	57	58	58	67	71	68
4																									
5	81	79	63	61	61	69	63	59	62	59	59	62	53	56	56	54	56	58	56	58	58	59	66	73	65
6	75	73	57	57	59	64	57	53	58	55	54	58	49	53	51	48	51	52	50	52	52	52	57	64	62

RUN NUMBER 100

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1	86	79	80	77	73	69	64	65	65	63	63	63	62	62	62	62	63	65	65	67	67	67	71	75	75
2	103	99	100	90	88	81	69	70	68	64	65	66	58	64	66	61	65	68	68	73	72	70	70	74	73
3	85	79	80	73	71	69	64	62	66	63	60	64	58	59	59	55	58	61	58	63	64	63	69	74	70
4																									
5	83	75	76	70	67	70	66	64	66	64	63	65	61	61	61	60	62	64	63	66	66	66	69	75	74
6	82	78	78	68	65	65	61	61	61	57	56	60	54	55	56	52	55	58	56	59	59	58	58	68	68

RUN NUMBER

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
1																									
2																									
3																									
4																									
5																									
6																									

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 101

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	55	48	48	47	47	47	39	36	35	36	34	34	29	30	26	17	20	21	15	7	10	7	3	9	21
8	54	47	47	46	47	46	42	36	35	35	34	34	28	29	27	17	21	22	16	6	10	4	-1	5	7
9	56	48	52	46	47	46	45	37	34	35	34	34	27	29	26	18	21	21	18	6	12	6	1	7	8
10	55	48	47	46	48	47	41	38	34	35	34	33	28	29	27	17	22	21	16	6	10	5	2	8	
11	57	49	49	51	51	49	45	42	39	33	29	25	17	20	21	10	12	12	4	-1	-4	-4	1	7	19
12	55	48	49	47	48	47	40	37	36	36	35	33	28	29	26	17	21	21	13	6	11	5	1	5	13
13	54	47	47	47	48	47	41	36	36	35	34	33	30	30	28	23	22	21	16	11	13	5	2	10	
14	55	47	47	46	47	47	42	38	34	35	35	34	31	30	28	23	23	23	16	15	12	3	2	9	-1
15	55	47	48	47	48	47	41	36	35	35	34	34	31	31	28	23	24	23	16	9	12	6	2	10	-1
16	54	48	47	46	47	46	42	37	34	34	34	33	28	29	27	18	22	22	13	3	12	6	3	9	-1
17	54	45	45	46	47	47	41	37	35	35	34	34	31	31	28	24	25	24	18	16	14	12	8	14	5
18	65	58	64	48	48	48	43	43	36	37	35	34	30	30	28	22	23	23	19	19	13	13	8	17	11

RUN NUMBER 102

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	59	48	47	47	46	46	47	47	51	52	51	47	43	39	35	30	31	33	33	29	32	32	23	18	8
8	57	46	47	46	46	45	46	44	47	49	48	45	41	38	36	29	32	32	30	32	29	30	25	18	9
9	58	48	52	46	46	45	47	44	47	49	48	45	40	38	34	27	31	32	30	31	30	30	23	16	11
10	67	48	47	48	49	52	56	58	61	61	59	56	50	46	43	37	39	39	39	36	40	40	29	25	
11	70	50	52	56	57	56	60	61	63	63	61	58	53	49	46	43	44	44	45	45	46	46	36	28	22
12	67	48	49	48	49	53	57	57	61	61	59	56	50	48	43	37	40	41	39	39	42	41	32	25	17
13	65	47	46	47	48	51	55	55	58	58	56	53	49	47	44	36	38	39	37	40	40	41	35	29	
14	61	46	46	45	45	48	51	51	55	53	52	49	45	43	42	35	41	39	36	39	40	38	33	29	15
15	55	46	45	44	44	44	45	42	46	42	42	41	34	39	39	30	40	33	29	27	30	27	19	23	4
16	61	46	45	45	45	48	50	50	54	53	52	50	45	44	44	35	40	40	39	39	39	39	34	29	21
17	65	44	45	46	47	52	56	54	58	58	57	54	50	47	45	39	42	41	40	41	41	42	38	30	18
18	69	56	63	49	49	55	59	58	60	60	59	56	51	48	43	38	40	40	39	41	40	40	33	30	20

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 103

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	69	49	50	50	49	51	53	52	58	62	63	61	59	56	51	46	44	44	41	38	42	39	43	47	34
8	67	48	48	49	49	49	49	49	55	59	60	59	57	55	51	45	44	43	38	39	38	39	39	41	34
9	67	49	52	48	49	49	50	49	55	59	61	59	56	54	49	43	43	42	38	38	39	39	37	36	32
10	77	50	52	52	53	56	61	64	68	71	71	69	66	63	59	54	52	50	47	45	49	48	51	53	35
11	80	55	57	62	61	61	65	67	70	72	73	72	69	66	63	59	57	56	54	53	55	54	56	58	49
12	77	50	53	52	53	57	61	63	68	70	71	70	67	64	60	54	53	53	48	48	52	49	50	52	42
13	74	50	50	50	51	54	58	60	65	67	68	67	64	63	58	51	49	49	45	45	48	49	48	51	41
14	70	53	47	48	49	50	53	56	61	63	63	62	59	59	55	47	48	48	43	45	49	46	43	47	43
15	61	55	44	45	45	42	41	44	50	49	53	52	47	50	49	37	45	45	33	31	39	34	32	40	20
16	70	51	45	47	49	50	52	55	60	62	63	63	60	59	56	46	48	49	45	42	49	48	46	52	49
17	75	48	48	49	51	54	58	59	65	68	69	68	65	63	59	54	53	52	48	48	50	50	52	54	47
18	77	57	63	52	53	57	62	64	68	70	71	70	67	63	59	54	52	51	47	50	50	48	51	53	42

RUN NUMBER 104

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	72	50	50	50	50	51	53	53	60	64	65	65	63	59	55	51	48	47	43	39	43	42	43	50	43
8	69	60	50	49	49	49	48	50	57	61	62	62	60	58	55	49	47	46	40	40	40	40	40	42	37
9	69	56	53	49	49	50	50	50	57	61	63	63	59	58	54	47	46	46	40	40	40	40	39	37	35
10	80	52	54	54	55	59	63	66	70	73	73	73	70	67	63	60	57	55	51	48	52	51	53	57	47
11	82	58	60	62	62	62	66	68	72	74	75	75	73	70	67	63	61	59	56	55	56	56	56	61	56
12	80	61	53	52	54	59	62	65	70	72	74	73	70	68	64	59	58	56	49	50	53	51	50	54	49
13	77	66	53	52	52	58	60	61	67	69	70	70	68	67	63	57	55	54	47	48	51	51	51	53	49
14	75	71	55	52	50	53	55	57	62	65	66	66	63	63	60	54	54	52	46	49	50	49	49	50	47
15	74	74	54	50	43	42	36	47	51	48	55	55	50	53	54	39	46	47	39	35	40	34	34	40	23
16	74	68	51	50	50	52	55	56	62	64	66	66	63	63	60	54	54	54	48	44	50	50	50	54	53
17	78	60	51	51	52	57	60	61	67	70	71	71	69	67	64	59	57	56	52	52	52	53	54	57	53
18	80	60	63	54	54	60	63	65	69	72	73	73	70	67	63	59	57	55	50	52	51	51	52	56	50

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 105

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	76	62	62	58	55	53	55	57	63	67	68	69	69	66	62	58	56	54	49	44	46	46	47	50	53
8	76	68	68	58	55	51	50	52	59	64	66	67	65	64	62	56	55	54	47	45	44	43	43	46	40
9	75	66	66	59	56	52	51	52	60	64	67	67	65	64	60	55	54	53	46	45	45	44	42	41	40
10	84	61	61	62	60	61	65	69	73	76	77	78	76	73	70	67	65	62	57	53	54	54	56	56	55
11	87	61	61	67	65	65	68	71	75	77	78	80	79	76	73	71	68	66	62	60	60	59	60	63	61
12	84	69	69	60	59	61	65	68	72	75	77	78	76	74	70	66	65	64	56	55	56	54	54	56	55
13	84	76	76	60	58	59	62	64	69	72	74	75	73	73	70	64	63	62	54	54	55	54	55	57	53
14	86	82	82	71	67	57	57	60	65	67	69	71	68	68	66	62	62	59	52	54	55	52	51	54	50
15	88	84	84	74	70	58	45	48	55	54	59	61	59	60	58	50	53	53	45	37	48	45	43	49	42
16	84	80	80	68	64	56	57	59	64	67	69	71	69	69	67	62	61	61	54	50	55	54	54	58	56
17	83	71	71	62	59	59	62	64	69	73	74	76	74	73	70	66	64	63	58	56	55	56	57	60	55
18	84	68	68	62	60	62	65	68	72	75	77	78	76	73	69	66	64	62	56	57	55	54	55	58	56

RUN NUMBER 106

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	53	48	48	45	44	42	38	31	30	30	30	31	28	28	25	16	18	19	8	5	11	5	3	9	5
8	53	47	47	45	44	43	42	33	30	30	30	31	27	27	25	16	20	20	12	6	10	4	0	6	11
9	56	49	53	46	44	42	45	35	31	30	31	31	26	28	24	16	20	21	12	6	12	5	1	7	10
10	53	48	47	45	44	43	40	34	30	29	30	31	27	28	26	16	20	20	8	4	8	4	3	9	
11	56	49	49	50	48	45	44	38	33	27	25	24	17	19	21	9	7	9	4	0	-2	-4	0	6	7
12	54	48	50	46	45	43	40	34	32	30	31	30	26	27	24	16	20	20	7	6	12	6	1	5	18
13	53	47	46	45	45	43	41	33	30	28	30	30	27	27	26	18	19	20	8	12	10	4	5	11	
14	53	47	47	45	44	44	42	34	29	28	31	31	28	28	26	16	20	20	8	12	8	2	4	10	5
15	53	48	47	46	45	43	40	32	30	29	30	30	27	27	25	16	20	20	7	4	9	3	3	9	-6
16	53	47	46	44	43	43	42	34	30	28	30	30	26	27	26	16	21	21	9	3	13	7	5	11	1
17	52	44	44	44	43	44	40	33	30	28	30	30	28	28	26	19	21	22	15	17	12	11	8	16	13
18	64	57	63	47	45	46	43	42	31	33	31	31	29	29	26	19	22	22	15	20	14	13	9	18	12

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 107

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	59	49	48	46	46	46	46	47	51	52	50	47	41	38	35	27	30	31	28	22	31	28	15	20	14
8	57	47	46	45	45	45	44	43	47	49	48	45	39	37	35	26	30	30	28	29	28	27	18	17	14
9	58	48	52	45	45	45	46	43	47	49	48	45	38	37	33	24	27	29	28	22	29	26	16	14	11
10	68	49	47	47	49	53	56	58	61	61	59	55	49	45	42	37	39	39	37	35	39	38	25	26	51
11	70	51	52	57	56	56	59	61	64	63	61	57	52	48	46	42	43	43	44	43	45	43	33	31	27
12	68	48	49	47	49	54	57	58	61	61	60	56	49	47	43	37	40	41	37	38	41	39	27	27	16
13	65	48	47	46	48	52	55	55	59	58	57	53	48	46	43	39	40	40	38	38	39	40	33	29	20
14	61	47	46	44	45	49	51	51	54	54	52	49	44	42	41	38	41	39	37	39	38	38	31	28	23
15	55	47	46	43	43	45	45	42	47	43	43	42	37	39	38	32	35	34	34	35	31	30	25	25	21
16	61	47	45	44	45	48	49	50	53	53	52	49	44	43	44	38	40	40	40	39	38	38	32	31	27
17	65	45	44	45	46	52	56	54	58	58	57	54	48	46	45	39	40	40	40	39	40	41	35	31	22
18	69	57	64	49	49	54	58	58	60	60	59	56	50	46	43	39	41	40	38	39	39	38	31	29	21

RUN NUMBER 108

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	70	51	49	49	49	51	52	53	60	64	64	62	60	56	51	47	45	44	40	37	41	38	43	45	32
8	68	49	48	48	48	49	48	50	57	61	61	60	57	55	51	45	44	43	38	39	38	38	38	39	32
9	68	49	53	48	49	49	49	50	57	61	62	60	57	55	50	43	41	41	39	37	38	38	36	36	31
10	79	52	52	52	53	59	63	66	70	73	73	71	67	63	59	55	53	51	47	45	48	47	52	52	34
11	81	55	57	62	61	62	66	68	72	74	74	73	70	66	63	59	57	56	54	53	55	53	56	57	46
12	79	52	53	52	54	59	63	65	70	73	73	71	67	65	60	55	55	54	47	49	51	48	49	51	41
13	76	52	52	51	52	58	61	62	68	69	70	69	66	64	59	54	53	52	46	47	48	48	50	52	45
14	72	52	49	48	49	54	56	58	63	64	65	64	61	60	56	51	51	50	45	47	48	47	45	49	45
15	62	52	43	44	45	45	43	47	53	52	55	53	50	51	50	38	45	45	36	31	40	36	32	41	23
16	72	50	46	47	49	53	56	57	62	64	65	64	61	60	56	51	51	51	47	46	49	48	47	52	50
17	77	48	48	49	51	57	60	62	67	70	70	69	66	63	60	55	53	52	50	49	49	50	52	54	47
18	79	57	63	52	53	60	64	65	69	72	73	71	67	64	59	54	52	51	47	49	48	47	50	52	41

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 109

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	73	53	54	50	50	51	53	55	62	66	67	67	64	60	56	51	49	48	43	40	43	41	43	49	43
8	71	58	54	50	50	50	48	51	58	63	64	64	62	60	56	50	48	46	40	42	40	40	40	41	37
9	71	57	56	50	50	51	50	51	58	63	64	64	61	59	55	48	45	45	41	40	39	39	37	36	35
10	81	55	56	52	55	60	65	68	71	74	75	75	71	68	63	59	58	55	48	44	50	49	50	55	43
11	84	58	62	62	62	63	67	70	74	76	77	77	74	71	67	63	61	59	56	55	56	55	56	61	55
12	81	60	56	53	55	61	65	67	71	73	75	75	71	69	65	59	58	57	50	50	52	50	49	53	48
13	79	65	56	54	54	60	63	64	68	71	72	72	70	68	64	59	57	56	51	50	51	51	53	54	53
14	76	71	57	53	51	54	58	59	63	65	67	67	65	64	61	55	55	53	47	47	50	48	48	50	47
15	74	73	57	50	46	46	45	48	54	54	57	58	56	57	54	43	47	47	41	39	44	42	40	44	38
16	75	68	53	50	50	53	57	59	63	65	66	67	65	64	61	55	54	54	49	48	50	49	49	53	53
17	79	60	53	51	53	58	62	63	68	71	72	72	70	68	65	59	57	56	52	51	52	52	54	56	52
18	81	61	64	54	55	62	66	67	70	73	75	75	71	69	64	59	57	56	51	52	51	50	52	55	51

RUN NUMBER 110

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	77	61	62	58	56	53	56	57	64	68	70	71	70	67	63	59	58	55	50	45	47	45	47	50	53
8	77	69	70	59	57	52	50	53	60	65	67	68	67	65	63	58	56	55	48	48	45	44	44	45	40
9	76	67	68	59	57	52	51	53	61	66	68	69	66	65	62	56	54	53	48	46	45	45	42	41	39
10	85	58	58	61	60	61	65	69	73	76	78	78	77	73	70	67	65	62	57	53	54	54	55	55	54
11	88	63	64	67	66	65	69	71	76	78	80	81	80	77	75	72	69	67	63	61	61	59	60	62	61
12	86	69	69	61	60	62	65	68	74	76	78	79	77	75	71	68	66	65	57	56	56	54	53	56	54
13	84	75	76	61	59	60	63	65	70	74	75	77	75	74	71	66	65	63	55	55	55	54	55	57	54
14	87	82	83	72	69	58	58	61	66	68	70	72	70	69	67	63	63	60	52	55	55	52	51	54	50
15	88	84	85	75	72	59	46	49	56	56	60	62	61	62	60	53	54	54	47	45	49	46	43	49	41
16	85	80	81	68	65	56	57	60	65	68	70	72	70	70	68	63	62	61	55	53	55	54	54	58	55
17	84	71	72	60	59	59	63	64	70	74	76	77	75	74	71	67	65	63	59	57	56	56	58	60	54
18	85	68	69	62	60	62	66	68	73	76	78	79	77	74	71	67	65	63	57	57	55	54	55	58	55

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 111

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	52	48	47	42	42	40	35	27	25	25	27	29	26	28	25	15	18	19	5	4	9	4	5	11	7
8	52	46	46	42	42	42	39	29	26	25	27	28	24	26	25	16	20	20	10	5	7	1	−0	6	10
9	55	48	52	43	42	41	42	33	27	26	28	29	23	26	24	15	19	20	10	6	11	9	6	12	27
10	51	47	46	42	42	41	35	29	25	24	26	28	23	26	25	15	18	18	6	2	3	−1	2	8	
11	53	48	47	46	45	43	39	33	29	22	23	23	15	19	18	7	6	9	0	−1	0	−2	−0	6	9
12	53	47	49	42	42	42	37	30	27	25	27	28	23	26	24	15	19	19	5	6	11	5	2	7	15
13	51	47	45	41	42	42	38	29	25	23	27	28	25	25	25	17	18	18	7	12	8	2	6	12	
14	51	46	46	42	42	43	38	30	25	24	28	29	26	26	25	16	20	20	11	12	8	2	4	10	11
15	52	46	46	42	43	42	36	28	25	24	27	28	25	26	25	15	20	20	11	7	11	5	3	9	−1
16	50	46	44	41	40	41	38	31	25	23	26	27	25	25	25	15	20	20	6	4	13	6	6	13	4
17	50	43	43	40	41	43	37	30	27	25	27	29	29	28	26	20	21	21	15	16	15	14	9	15	6
18	65	57	64	45	43	45	41	41	28	32	28	30	28	27	26	19	22	22	14	19	15	13	10	18	12

RUN NUMBER 112

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	53	48	48	44	43	41	37	33	34	33	32	32	28	29	26	17	20	21	12	6	9	4	3	9	3
8	53	47	46	44	44	44	41	35	34	34	33	33	28	28	26	18	21	22	14	6	8	3	1	7	10
9	55	48	52	44	43	42	43	36	35	34	33	32	29	29	27	18	22	21	15	6	10	14	12	18	31
10	53	48	47	44	43	42	36	33	33	32	31	32	28	28	26	17	20	20	12	5	7	2	1	7	
11	55	49	49	49	48	45	41	37	35	31	28	27	19	21	23	10	13	15	4	0	0	−3	−0	6	8
12	53	48	48	44	44	44	39	35	34	33	32	32	28	28	25	18	22	21	11	6	10	5	1	6	36
13	53	48	46	44	43	43	40	34	34	33	33	32	29	28	26	20	21	21	11	12	8	2	6	12	
14	53	47	46	44	44	45	40	35	34	33	33	32	29	29	27	19	22	22	11	13	9	3	5	11	15
15	53	47	47	44	44	44	39	33	34	33	32	32	29	29	27	19	23	22	12	6	10	4	2	8	−4
16	52	47	45	43	42	43	39	35	34	32	31	31	28	28	27	18	22	22	12	6	12	6	7	13	−0
17	51	43	43	42	42	45	38	33	33	33	32	32	31	30	28	22	23	23	16	17	12	10	8	15	12
18	65	58	64	46	44	46	42	43	35	37	33	33	31	30	28	23	25	24	17	20	13	11	8	18	11

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 113

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	64	49	50	51	52	53	53	53	56	57	54	51	47	44	42	36	37	38	36	34	36	34	32	33	31
8	62	48	49	50	50	51	50	50	53	53	52	50	47	46	42	37	40	41	39	38	35	35	30	27	23
9	62	49	53	50	50	51	51	50	53	54	52	50	47	45	42	37	41	41	39	37	36	35	30	24	23
10	73	50	51	54	56	61	65	66	66	65	63	59	55	52	50	44	45	46	44	42	44	42	40	39	32
11	76	53	56	63	64	64	67	68	68	67	64	62	58	55	53	50	51	51	51	50	50	49	46	46	42
12	73	50	52	54	56	62	64	65	66	65	63	60	56	54	50	45	47	49	45	47	46	44	40	38	35
13	71	49	50	52	55	60	62	62	63	62	60	58	55	54	50	48	49	50	47	47	46	45	43	41	37
14	67	48	49	50	51	56	57	57	59	58	56	54	51	51	49	47	49	51	49	48	49	46	43	42	38
15	55	43	43	42	41	44	43	42	45	42	42	41	38	39	40	36	41	43	40	38	38	36	33	34	30
16	66	48	48	48	50	54	56	57	58	56	56	54	51	50	51	47	50	52	50	49	47	46	44	45	42
17	71	46	48	50	53	59	62	62	63	63	62	59	56	54	51	48	50	51	49	48	47	46	45	43	37
18	73	57	64	54	56	62	65	65	65	64	63	60	56	54	50	47	48	47	46	47	45	43	41	41	37

RUN NUMBER 114

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	76	51	51	54	55	58	61	62	68	70	69	65	63	59	56	51	50	50	47	46	48	47	48	50	46
8	72	50	50	52	53	55	55	58	64	66	65	63	61	60	56	51	51	51	48	50	48	47	44	44	38
9	73	50	53	52	53	55	56	58	64	67	66	64	61	58	55	51	51	51	49	50	49	48	45	42	39
10	84	54	54	57	60	67	73	74	77	78	77	74	70	67	64	60	59	57	55	53	55	55	56	56	47
11	86	58	60	67	67	70	74	77	80	80	78	76	73	69	67	65	63	62	62	61	62	61	61	62	57
12	84	54	54	57	60	68	72	74	77	78	77	74	71	68	64	60	60	60	56	58	58	57	55	55	50
13	82	54	53	55	59	66	70	71	74	75	74	72	69	67	64	61	59	59	56	58	59	58	57	57	52
14	78	55	50	52	55	61	64	65	70	71	70	67	65	64	62	59	60	60	58	59	61	58	56	57	52
15	68	58	45	46	47	50	52	54	61	58	59	58	56	56	54	48	53	54	51	52	53	50	48	49	44
16	77	53	48	51	54	60	64	65	68	69	69	67	64	64	62	59	60	61	59	60	60	59	57	59	57
17	82	49	49	53	57	65	70	70	74	76	75	72	70	68	64	61	60	60	59	60	59	59	58	59	52
18	84	58	63	56	60	68	72	74	76	77	77	74	70	67	64	61	60	57	55	59	57	55	55	56	50

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 115

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	78	52	54	55	56	59	62	64	70	73	72	69	67	63	59	54	53	53	49	46	50	49	51	53	50
8	75	60	52	53	54	57	57	60	66	69	69	67	65	63	59	55	54	54	50	51	50	50	47	47	41
9	76	57	54	53	55	57	58	60	66	69	69	67	64	62	58	54	54	53	50	51	51	50	47	43	40
10	87	54	57	58	61	67	73	76	79	81	80	77	74	70	67	63	62	60	56	55	58	57	59	59	51
11	89	60	63	67	68	70	76	78	82	83	82	79	77	73	71	68	67	65	64	63	65	64	64	65	61
12	87	62	56	57	61	68	73	75	80	81	81	77	74	71	67	63	63	63	57	59	60	59	57	58	54
13	85	65	56	57	60	66	71	72	77	78	78	75	73	71	67	64	63	63	59	60	61	61	61	60	57
14	81	71	56	55	56	62	65	67	72	73	73	71	68	68	65	63	64	63	61	61	63	61	59	59	56
15	76	74	56	53	50	52	53	57	63	61	63	62	60	60	58	54	56	58	55	55	56	55	52	54	50
16	80	69	53	53	56	60	65	67	71	72	72	71	68	67	65	63	64	64	62	63	63	62	61	63	61
17	85	60	53	55	58	65	71	72	76	79	79	76	73	71	68	65	64	63	62	63	61	62	61	62	56
18	87	61	64	58	61	68	73	76	79	80	80	78	74	71	67	65	63	61	58	61	60	59	59	60	55

RUN NUMBER 116

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																							
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	83	60	60	60	59	59	64	66	73	77	77	75	72	70	65	61	59	59	55	51	53	53	56	58	56
8	81	69	69	60	58	57	58	62	70	73	74	73	70	69	65	60	60	60	55	55	53	53	52	52	45
9	81	66	67	60	59	58	59	62	70	73	74	73	69	68	64	60	60	59	56	56	55	55	54	50	47
10	91	58	56	62	64	69	75	78	83	85	85	84	80	77	73	69	68	66	62	59	62	62	64	64	58
11	94	64	64	70	70	72	77	81	85	87	87	86	82	80	77	74	73	72	69	68	69	68	69	70	66
12	92	69	69	62	64	70	75	78	83	85	85	84	80	78	74	70	70	69	63	64	64	64	63	64	61
13	90	75	76	61	62	68	72	75	80	82	82	82	78	77	73	70	70	69	64	64	65	65	66	66	63
14	88	82	83	72	69	64	67	70	75	77	78	77	74	74	71	69	70	69	66	65	67	65	64	64	61
15	88	84	85	75	72	59	55	59	66	65	67	67	66	67	63	60	62	62	58	58	60	58	56	57	54
16	87	80	81	68	66	62	67	70	74	76	77	77	74	73	71	69	70	70	67	67	67	67	67	68	66
17	90	71	72	61	62	67	72	74	80	83	83	83	79	78	74	71	70	69	67	68	66	67	67	68	62
18	91	69	69	63	64	70	75	78	82	84	85	84	80	77	73	71	70	67	64	66	65	64	65	66	62

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 117

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	53	48	48	46	45	43	35	31	28	25	25	26	20	23	22	13	13	19	12	7	12	6	8	15	6
8	53	48	47	46	46	44	39	31	29	25	25	25	19	21	23	12	17	19	8	6	6	2	4	10	23
9	56	48	52	46	46	43	42	37	30	28	28	27	22	24	23	14	18	20	16	6	12	8	4	9	20
10	53	48	47	46	46	44	37	32	29	25	26	25	19	22	23	12	16	20	14	6	9	4	6	12	7
11	55	48	48	49	49	45	40	36	31	23	23	21	10	16	17	9	7	10	4	2	2	-1	1	6	7
12	53	47	48	46	45	44	38	34	30	27	26	26	19	22	23	11	17	20	12	6	11	5	3	9	18
13	53	47	46	46	45	43	38	33	30	26	26	25	22	22	24	13	16	19	9	12	7	1	5	11	
14	54	48	47	46	46	44	39	33	29	26	27	26	22	23	24	13	17	20	8	12	9	3	6	11	7
15	54	48	47	46	46	44	38	32	30	27	26	25	20	21	24	12	18	20	7	6	11	5	3	9	-7
16	53	47	46	45	45	42	39	33	29	25	25	24	20	21	24	12	17	20	10	4	12	6	8	14	-1
17	51	43	43	44	44	44	37	32	30	27	26	25	23	23	24	17	20	21	13	17	12	8	8	15	14
18	67	59	66	48	46	46	45	47	32	34	28	28	24	25	25	18	21	22	13	19	13	10	9	19	10

RUN NUMBER 118

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	65	50	51	53	53	54	55	55	56	56	54	50	48	46	43	38	39	42	40	37	37	34	36	39	36
8	63	50	50	53	52	53	51	52	53	53	52	50	49	48	46	42	44	46	45	42	40	37	36	33	26
9	63	50	53	53	53	53	52	52	53	53	52	50	48	47	45	42	45	46	44	44	42	38	35	31	29
10	73	52	53	56	57	62	65	66	66	65	63	60	56	54	52	47	49	50	47	44	47	44	46	46	39
11	77	54	58	64	64	65	68	69	69	67	64	62	59	57	56	54	55	56	56	54	53	51	50	51	47
12	74	51	53	56	58	63	66	66	67	65	64	61	58	56	53	49	52	54	51	50	50	46	45	46	42
13	71	51	52	55	56	60	62	63	64	62	60	58	57	56	54	51	52	54	52	50	48	47	46	45	41
14	68	49	50	53	53	56	57	58	59	58	57	55	54	55	54	53	55	56	56	55	50	49	45	43	40
15	64	49	49	51	50	51	49	49	52	51	51	51	50	51	51	50	53	54	50	49	49	44	42	42	39
16	68	49	49	52	52	55	57	58	58	57	56	55	54	54	54	53	56	57	55	54	53	50	48	49	47
17	72	47	48	53	55	60	63	63	64	63	62	59	57	56	54	53	55	56	54	54	50	49	48	48	42
18	74	58	64	55	57	62	65	66	66	64	62	60	57	55	51	50	52	52	51	51	46	45	44	45	42

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Continued

RUN NUMBER 119

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	76	53	53	56	56	59	61	62	68	71	69	65	62	59	56	52	51	54	52	50	51	49	51	53	50
8	74	51	51	54	54	56	57	59	65	67	66	64	61	60	58	55	56	58	56	55	54	51	51	49	42
9	74	51	53	54	55	57	57	59	65	68	67	64	61	60	57	55	57	58	56	58	56	52	50	47	45
10	85	56	56	59	61	68	72	75	78	79	77	74	70	68	65	61	61	62	60	58	60	59	60	60	53
11	87	60	61	68	68	71	75	77	81	81	79	76	72	70	69	66	66	67	67	66	66	65	64	64	60
12	86	56	56	60	62	69	73	75	79	80	78	74	71	69	66	62	63	65	63	63	63	60	59	60	56
13	82	55	55	57	59	66	69	71	75	76	74	72	69	68	66	63	65	66	63	63	62	62	60	60	55
14	79	56	50	53	55	61	64	66	70	71	70	68	66	66	64	64	67	68	67	67	64	62	59	57	52
15	73	58	46	48	49	52	53	56	62	62	63	62	60	61	60	59	63	64	59	60	60	56	54	54	50
16	80	54	49	53	55	60	64	66	69	70	70	68	66	65	65	65	68	69	66	67	66	64	62	63	61
17	84	51	51	56	58	66	69	71	75	77	76	73	70	69	67	65	66	67	66	67	64	64	62	63	57
18	85	60	64	59	61	69	73	75	78	78	77	74	71	68	65	63	64	64	64	64	62	60	60	60	56

RUN NUMBER 120

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	79	54	56	56	58	60	63	64	70	74	73	69	66	62	59	55	54	56	55	53	54	53	54	57	54
8	77	61	54	55	56	58	58	61	67	70	70	67	65	63	61	58	59	61	59	59	58	55	55	52	45
9	77	58	55	55	56	58	59	61	68	71	71	68	65	63	60	58	61	62	60	61	59	57	54	51	48
10	88	56	59	60	63	69	74	77	80	83	81	78	74	71	68	64	64	65	62	59	63	62	63	63	56
11	90	62	65	69	69	72	77	79	83	84	83	80	76	73	72	70	70	70	70	69	69	68	68	68	64
12	89	62	58	60	64	70	74	76	81	83	82	78	74	72	69	65	66	68	65	65	66	64	63	64	59
13	85	67	57	58	61	67	71	72	77	79	78	76	72	72	69	66	68	69	66	66	65	65	63	63	58
14	83	73	56	56	57	62	66	67	72	74	74	71	69	69	68	67	70	70	70	70	67	66	63	61	57
15	78	75	56	53	51	54	54	57	64	64	66	66	64	64	63	62	66	67	62	63	64	60	57	58	53
16	83	70	54	54	57	61	66	67	71	73	73	72	68	68	67	68	71	72	69	70	70	67	65	67	64
17	87	60	54	57	60	67	71	72	77	80	80	77	73	72	70	68	70	70	68	70	68	67	66	66	60
18	88	62	65	60	63	70	74	76	80	82	81	79	74	71	68	66	67	67	66	67	65	63	63	64	60

TABLE 6.- ROTATING-AIRFOIL VORTEX-NOISE SOUND PRESSURE MEASUREMENTS – Concluded

RUN NUMBER 121

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	84	60	61	60	61	62	65	67	74	78	78	76	73	70	66	61	60	62	61	58	59	59	61	64	60
8	83	70	72	62	61	60	60	63	71	74	75	75	71	70	67	63	64	66	65	63	64	61	63	60	53
9	83	68	70	61	61	60	61	63	71	75	76	75	71	69	66	63	66	68	66	66	64	63	59	57	54
10	93	58	58	64	66	71	76	79	83	86	87	85	81	78	74	71	69	70	67	66	69	68	71	71	64
11	95	67	68	72	72	74	79	81	86	88	88	87	83	80	78	77	76	76	75	75	75	75	75	75	70
12	93	69	70	65	68	72	76	79	84	87	88	86	81	79	75	71	72	74	71	71	72	70	70	71	68
13	91	76	78	65	65	69	73	75	80	83	83	83	79	78	75	72	73	75	73	71	72	71	71	71	67
14	90	83	85	74	72	65	68	70	75	77	78	78	75	76	74	72	75	76	76	76	73	73	70	67	62
15	90	85	87	76	74	61	56	60	68	68	71	71	70	70	67	64	69	70	65	66	67	63	61	62	58
16	90	81	83	70	68	64	68	70	74	77	78	78	75	75	73	73	76	77	75	76	75	73	71	72	70
17	91	71	72	61	64	68	73	75	80	84	85	84	80	78	75	73	75	76	74	76	73	73	72	73	67
18	93	69	70	64	66	71	76	79	83	85	87	86	81	78	74	72	73	73	72	73	70	69	70	71	67

RUN NUMBER 122

Microphone position	Overall sound pressure level, dB	Amplitude, in dB, for 1/3-octave-band frequency, in Hz, of:																						
		50	63	80	100	125	160	200	250	315	400	500	630	800	1k	1.2k	1.6k	2k	2.5k	3.1k	4k	5k	6.3k	8k	10k
7	55	50	51	49	45	43	37	34	34	29	29	28	20	25	23	13	12	17	-1	0	4	3	6	12	8
8	56	51	50	49	45	43	38	33	36	31	29	28	21	25	25	16	13	20	11	7	6	1	3	9	13
9	57	51	53	50	46	44	42	42	35	31	30	29	23	26	26	15	14	22	15	10	15	18	18	24	31
10	56	51	50	49	45	44	38	33	36	30	30	28	22	25	26	14	15	20	12	10	10	5	5	11	39
11	87	81	81	82	78	75	71	67	67	59	58	55	41	49	49	42	40	43	39	36	33	31	35	41	42
12	56	50	51	49	45	44	39	38	35	31	31	28	22	25	25	14	17	20	10	9	11	8	7	13	29
13	55	50	50	48	45	43	37	34	35	31	30	28	24	24	25	17	19	21	11	12	11	5	6	12	
14	56	50	50	49	46	44	39	35	36	32	31	29	25	25	25	15	19	20	10	14	12	5	5	11	10
15	56	50	50	49	46	44	39	34	37	32	31	28	23	25	25	15	21	21	9	7	14	7	4	10	-2
16	55	50	49	48	44	43	38	35	36	31	30	27	22	24	25	14	20	21	13	7	15	8	6	13	4
17	53	46	47	47	44	43	38	34	36	32	31	29	26	26	25	19	21	22	15	17	14	12	7	16	17
18	68	60	66	51	46	44	52	55	37	36	32	32	27	27	25	18	22	22	13	20	14	12	9	18	8

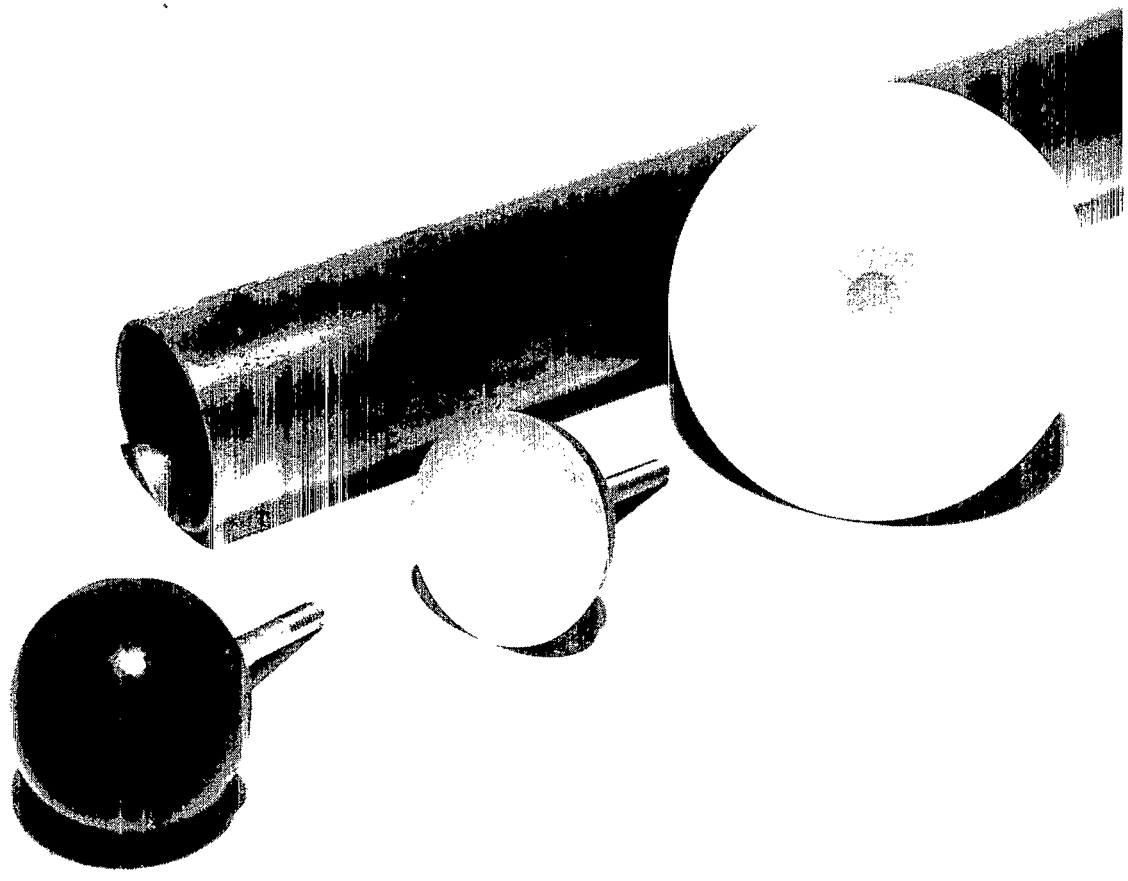
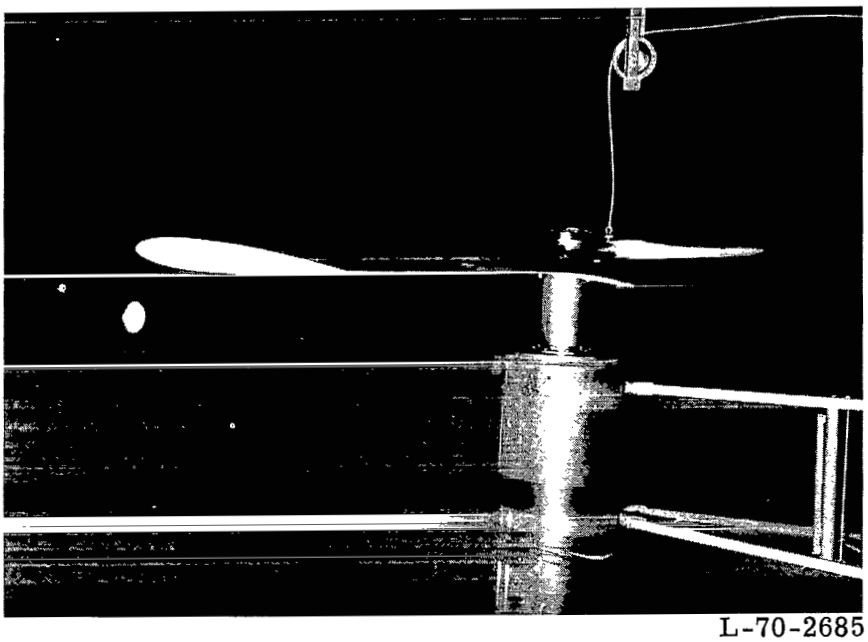
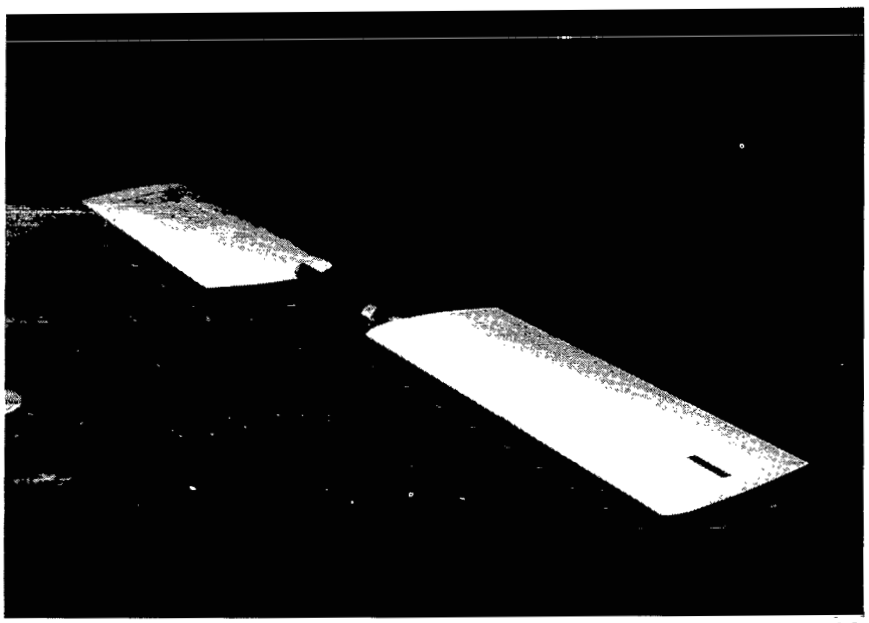


Figure 1.- Photograph of cylindrical blade end and various tip configurations. L-70-2679.1



L-70-2685

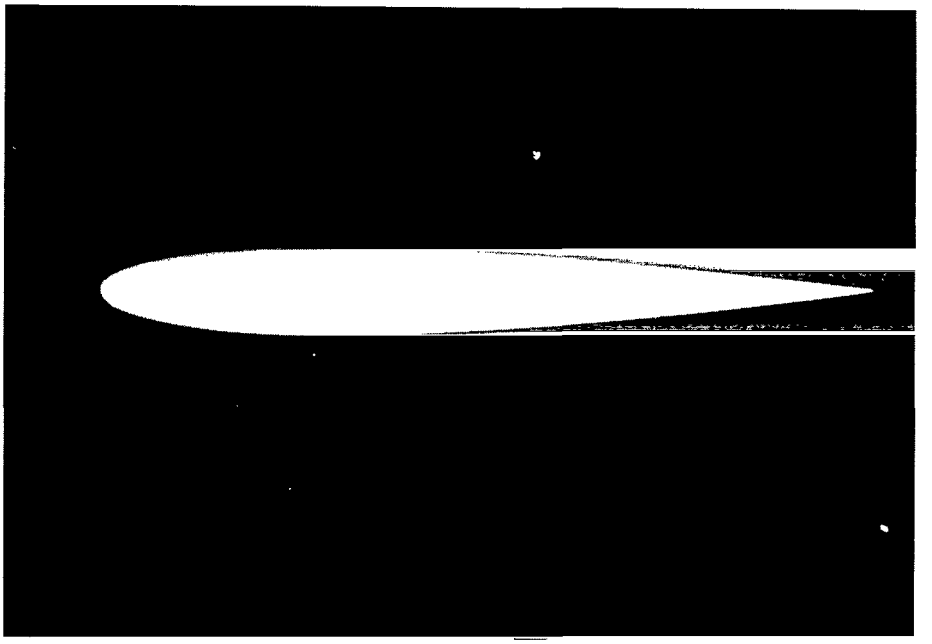
(a) Helically twisted blade.



L-70-2682

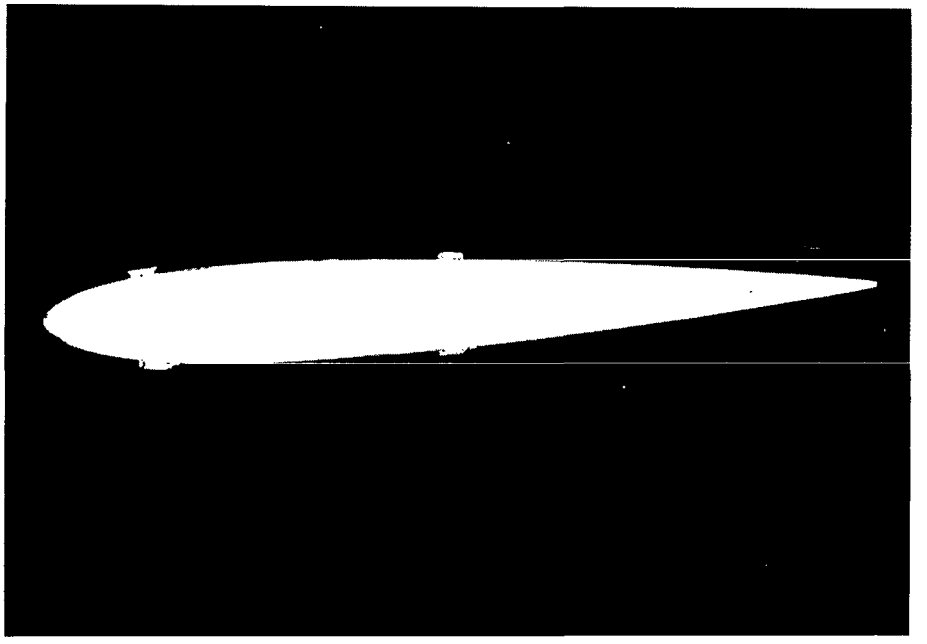
(b) Untwisted blade.

Figure 2.- Photograph of airfoil test models.



L-70-2687.1

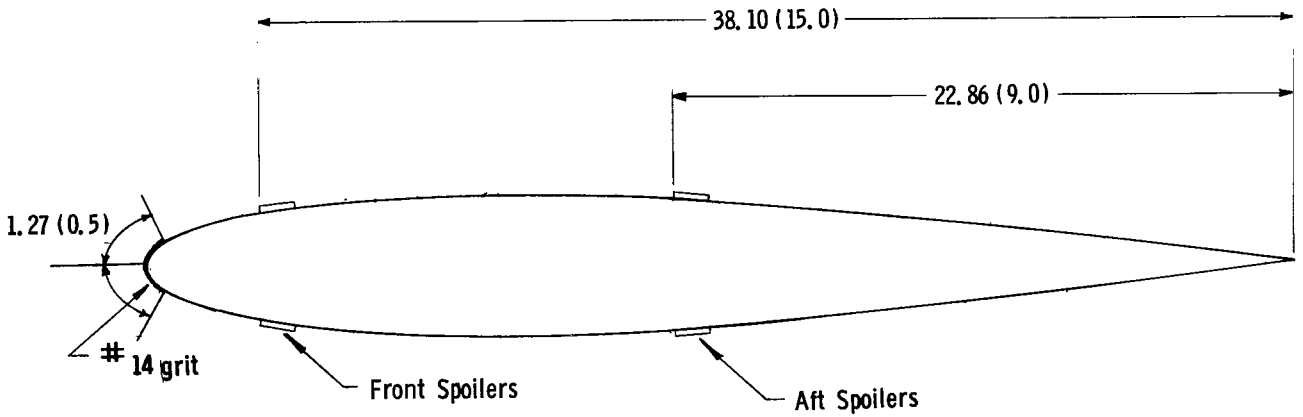
(c) Plain NACA 0012 airfoil section.



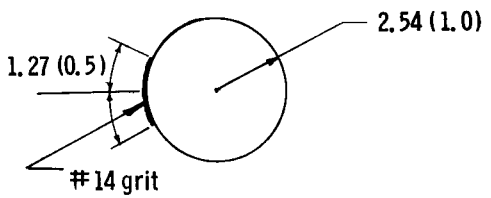
L-71-5064.1

(d) Modified NACA 0012 airfoil section to simulate changes in airfoil shape.

Figure 2.- Concluded.

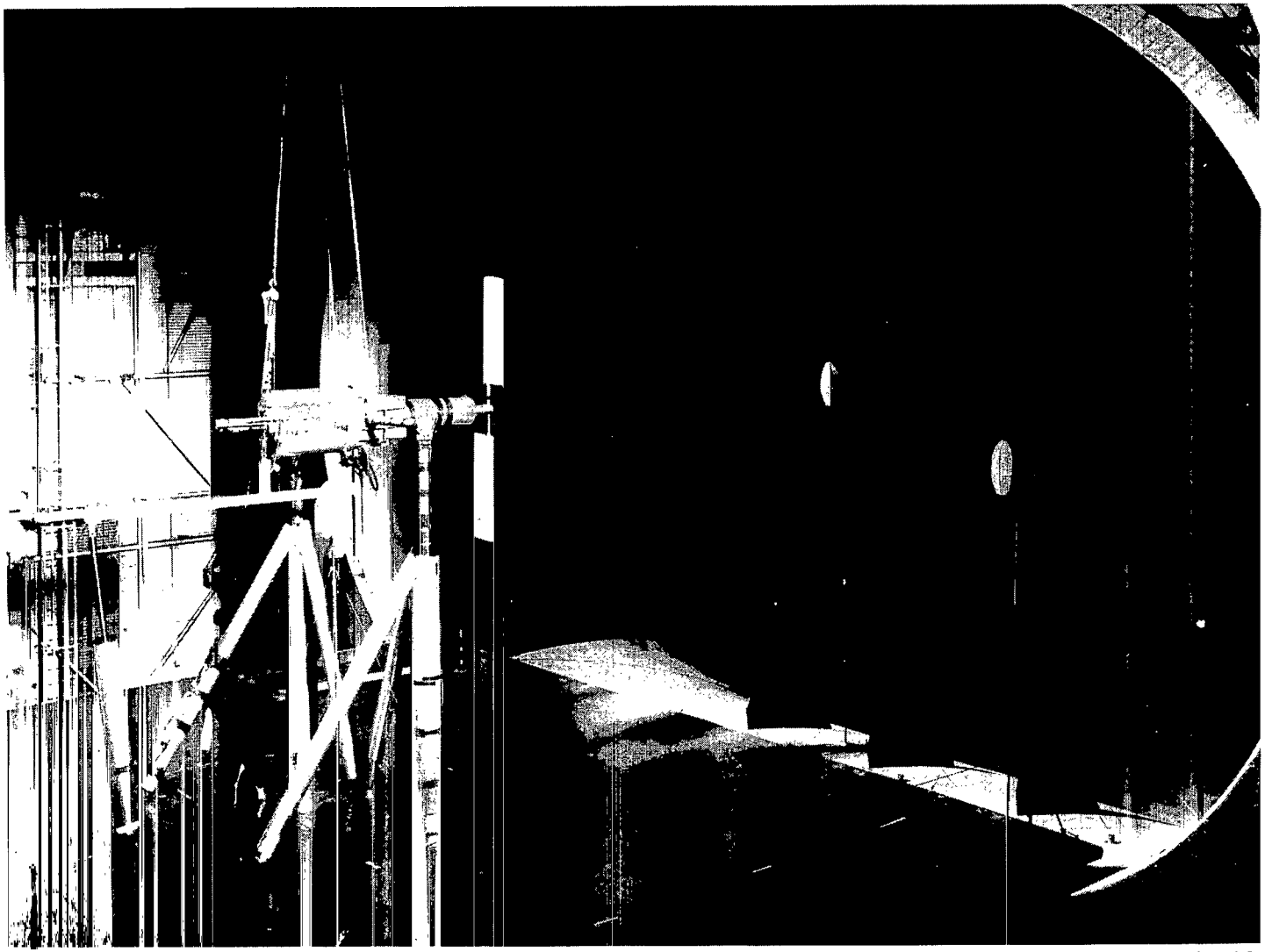


(a) NACA 0012 airfoil-section blade.



(b) Cylindrical blade.

Figure 3.- Blade cross section indicating the location of the grit and the spoilers. All dimensions are in centimeters (inches).

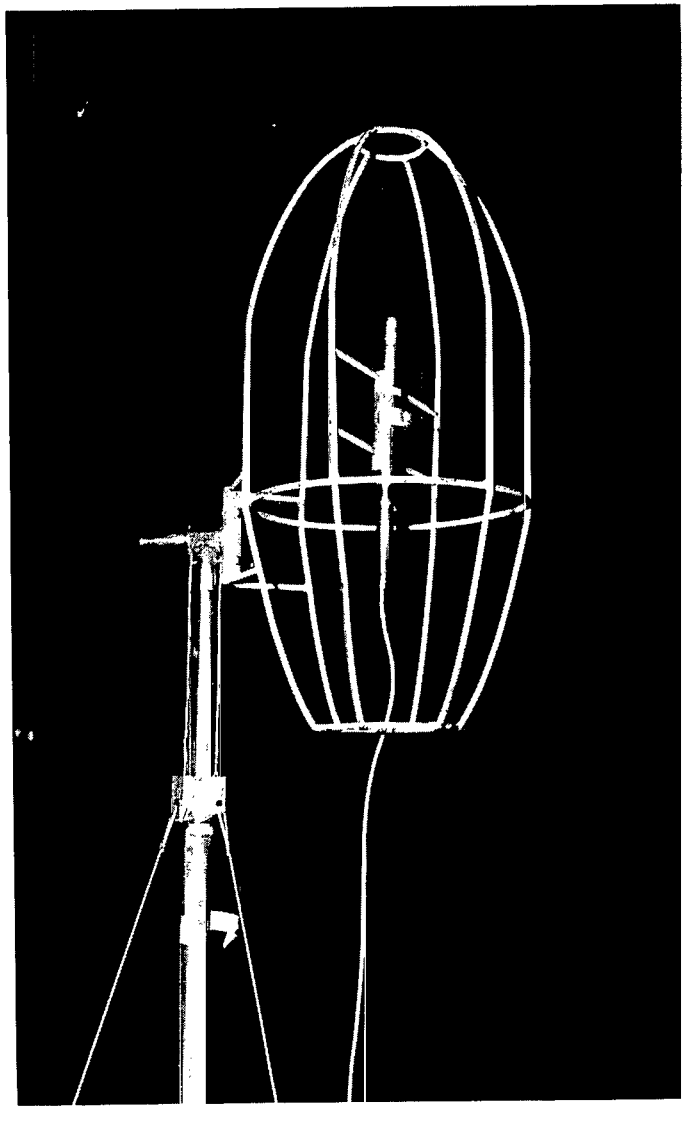


L-71-632

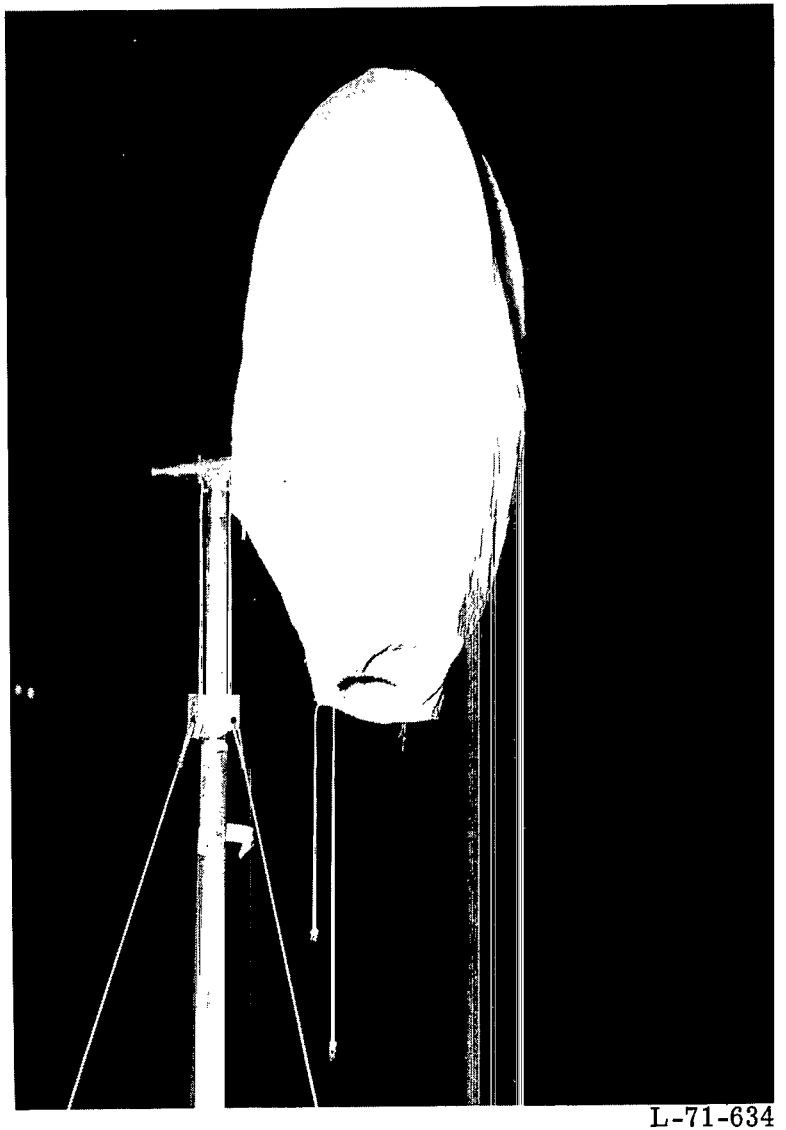
Figure 4.- Photograph of the model setup in Langley full-scale tunnel.

L-71-633

Figure 5.- Photograph of the model setup for outdoor tests.



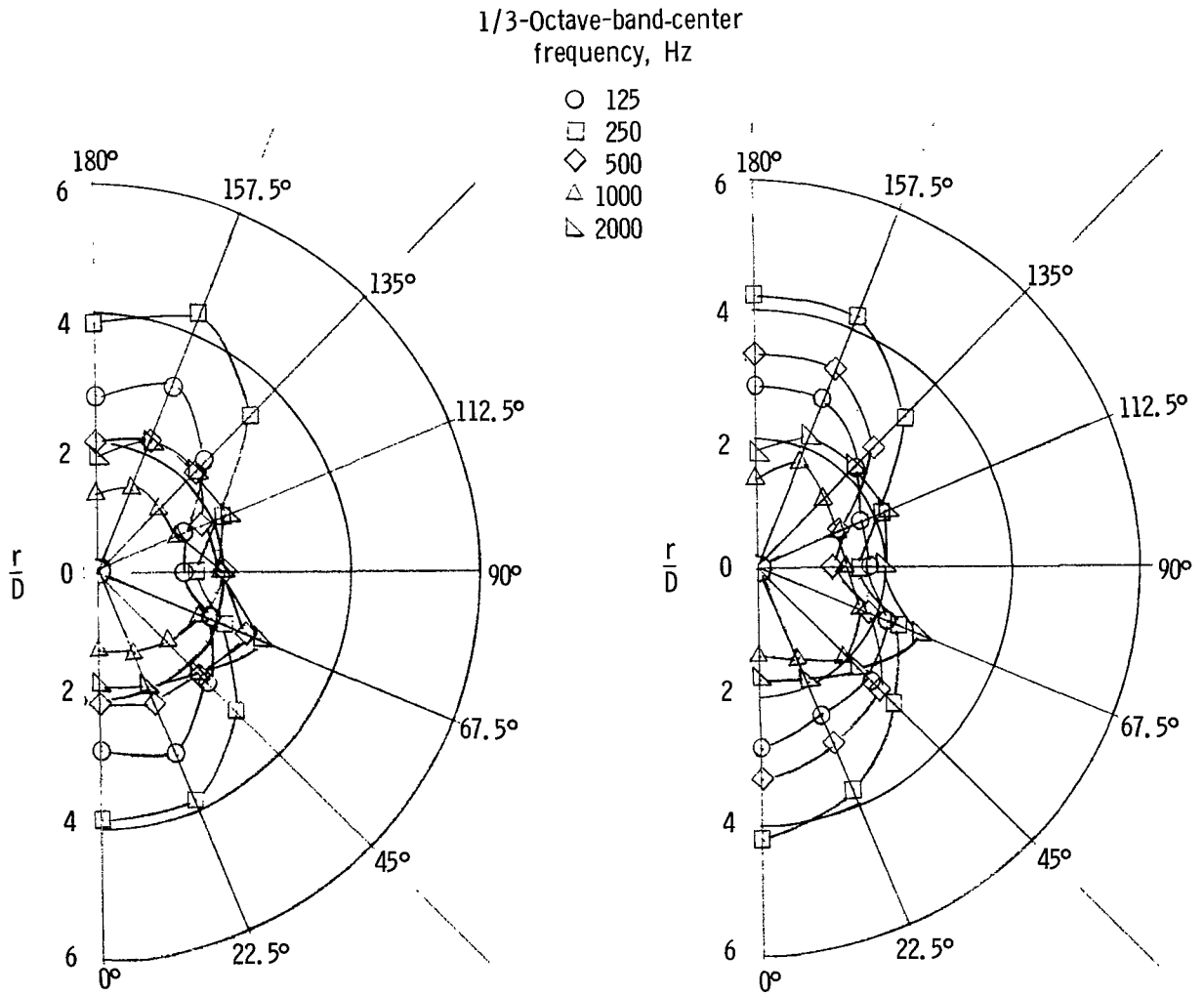
(a) Microphone.



L-71-634

(b) Wind screen.

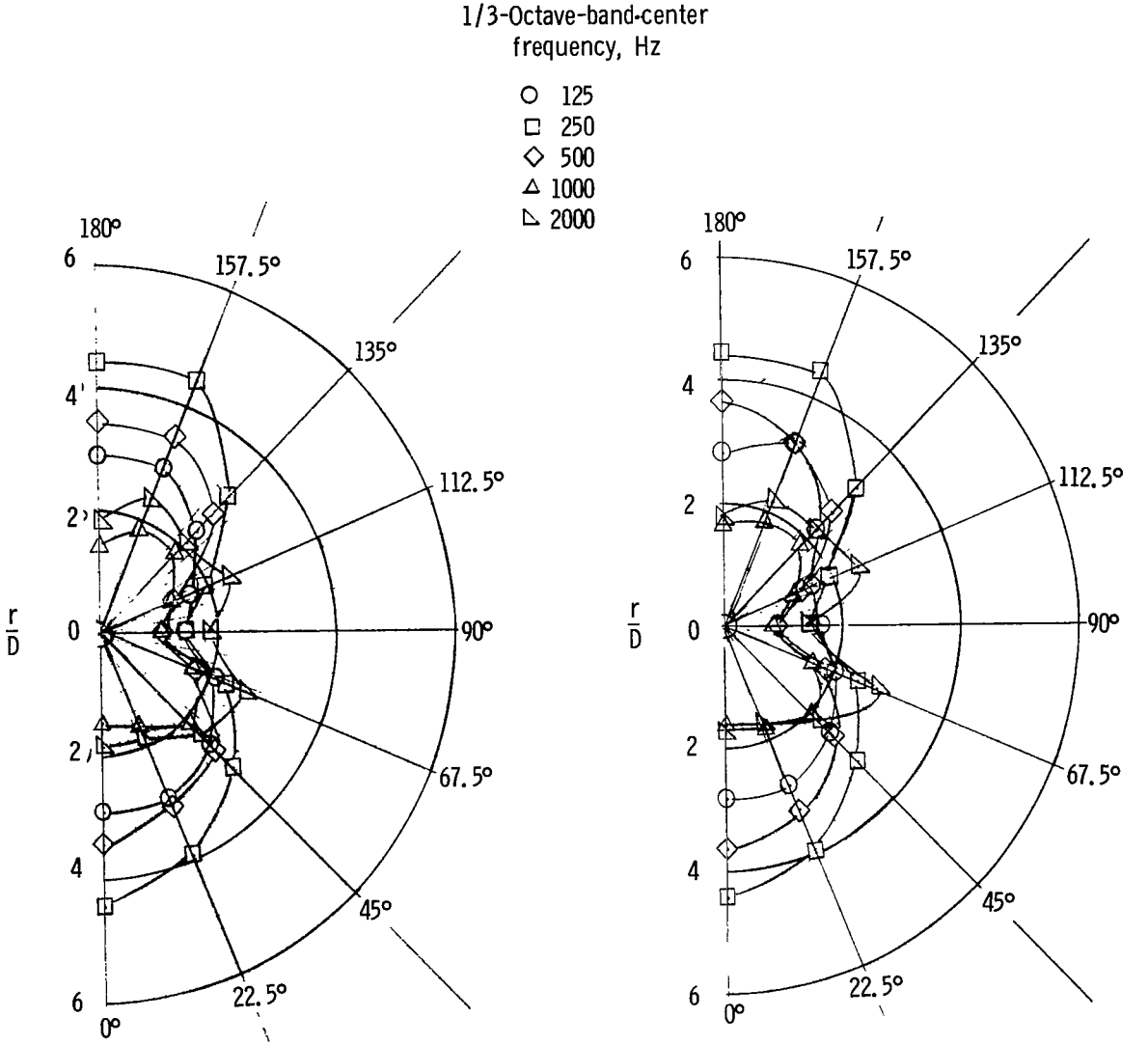
Figure 6.- Photograph of microphone and wind screen.



(a) N_0 = 400 rpm.

(b) N_0 = 700 rpm.

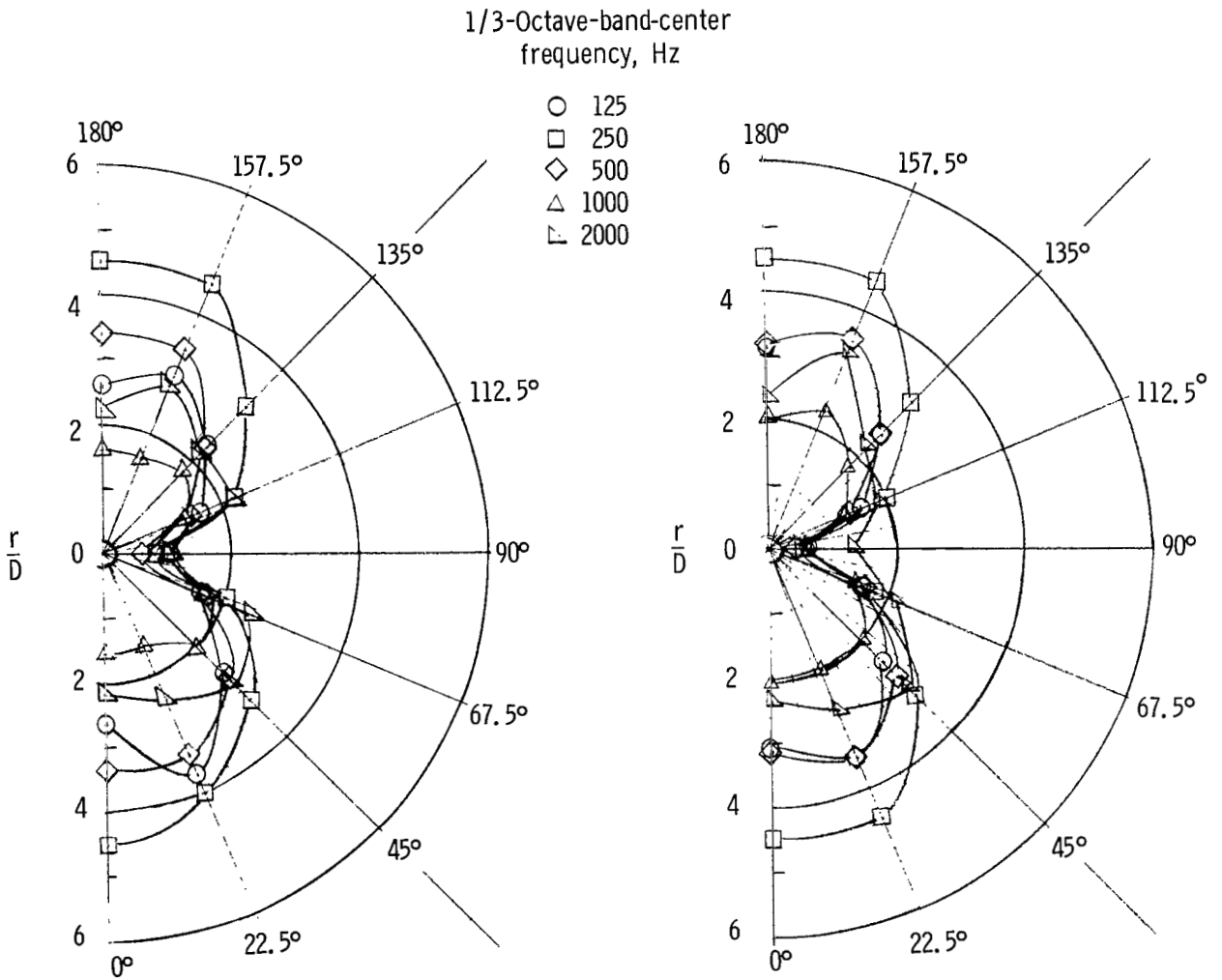
Figure 7.- Estimated wind-tunnel hall radius for various azimuth positions and for a 1/3-octave-band-center frequency. Data for model 01 operating at four rotor rotational speeds. The zero azimuth position is alined with the rotor rotational axis.



(c) N_0 = 850 rpm.

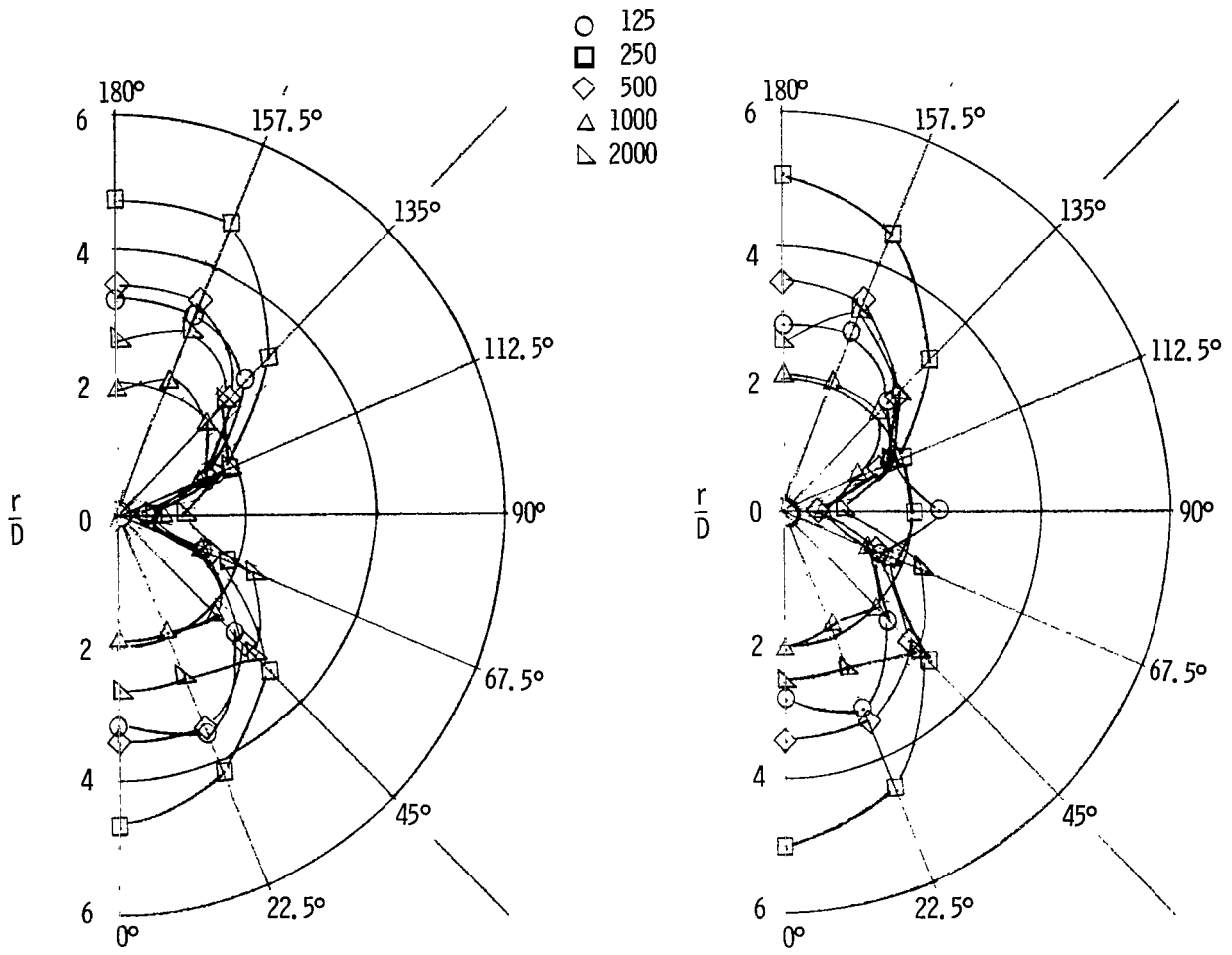
(d) N_0 = 900 rpm.

Figure 7.- Concluded.



(a) N_0 = 400 rpm. (b) N_0 = 625 rpm.

Figure 8.- Estimated wind-tunnel hall radius for various azimuth positions and for a 1/3-octave-band-center frequency. Data for model 10 operating at four rotor rotational speeds. The zero azimuth position is alined with the rotor rotational axis.



(c) N_0 = 700 rpm.

(d) N_0 = 850 rpm.

Figure 8.- Concluded.

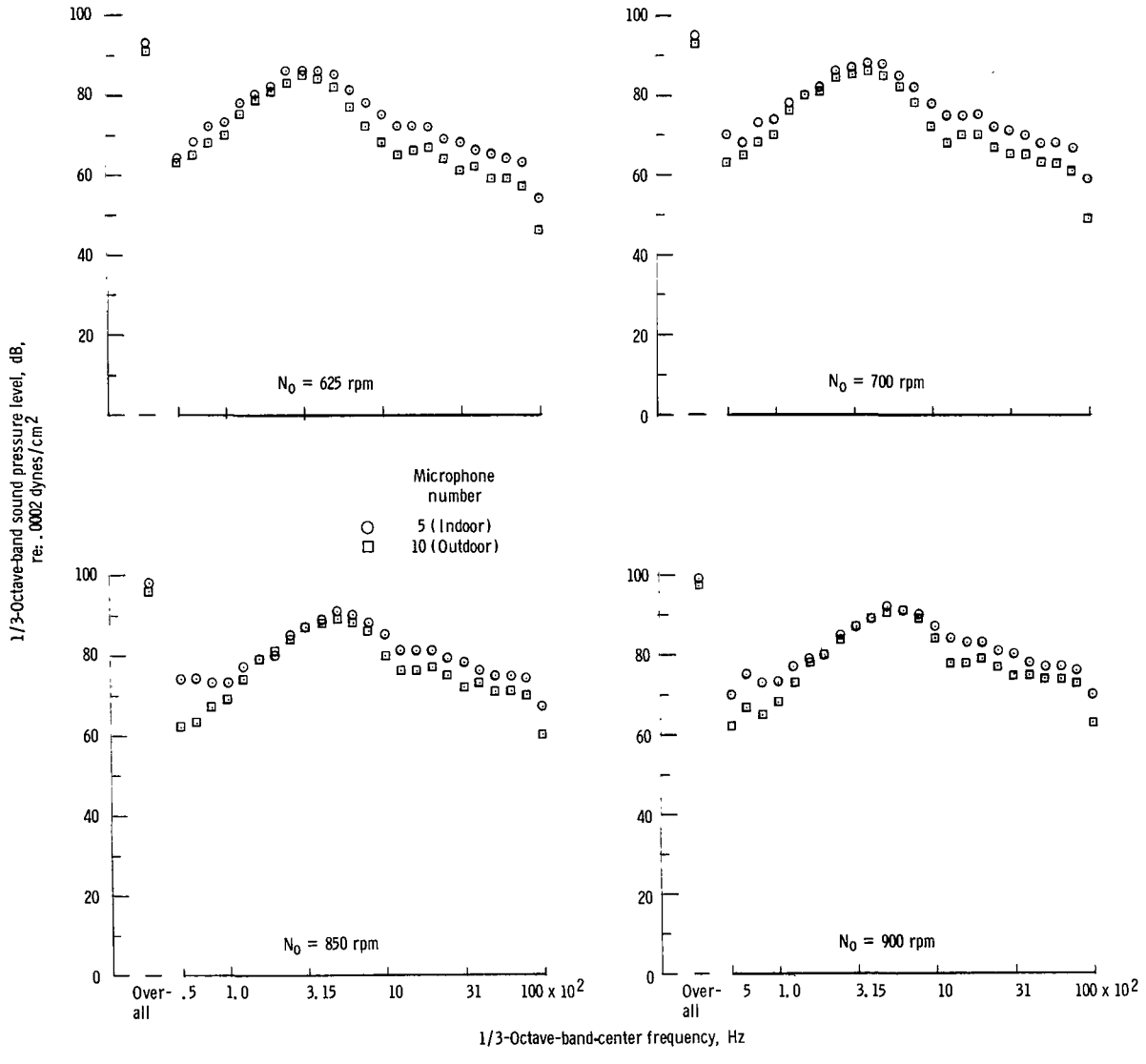


Figure 9.- Comparison of indoor and outdoor noise data for the same microphone position and different rotor rotational speeds of model 01 with zero axial velocity.

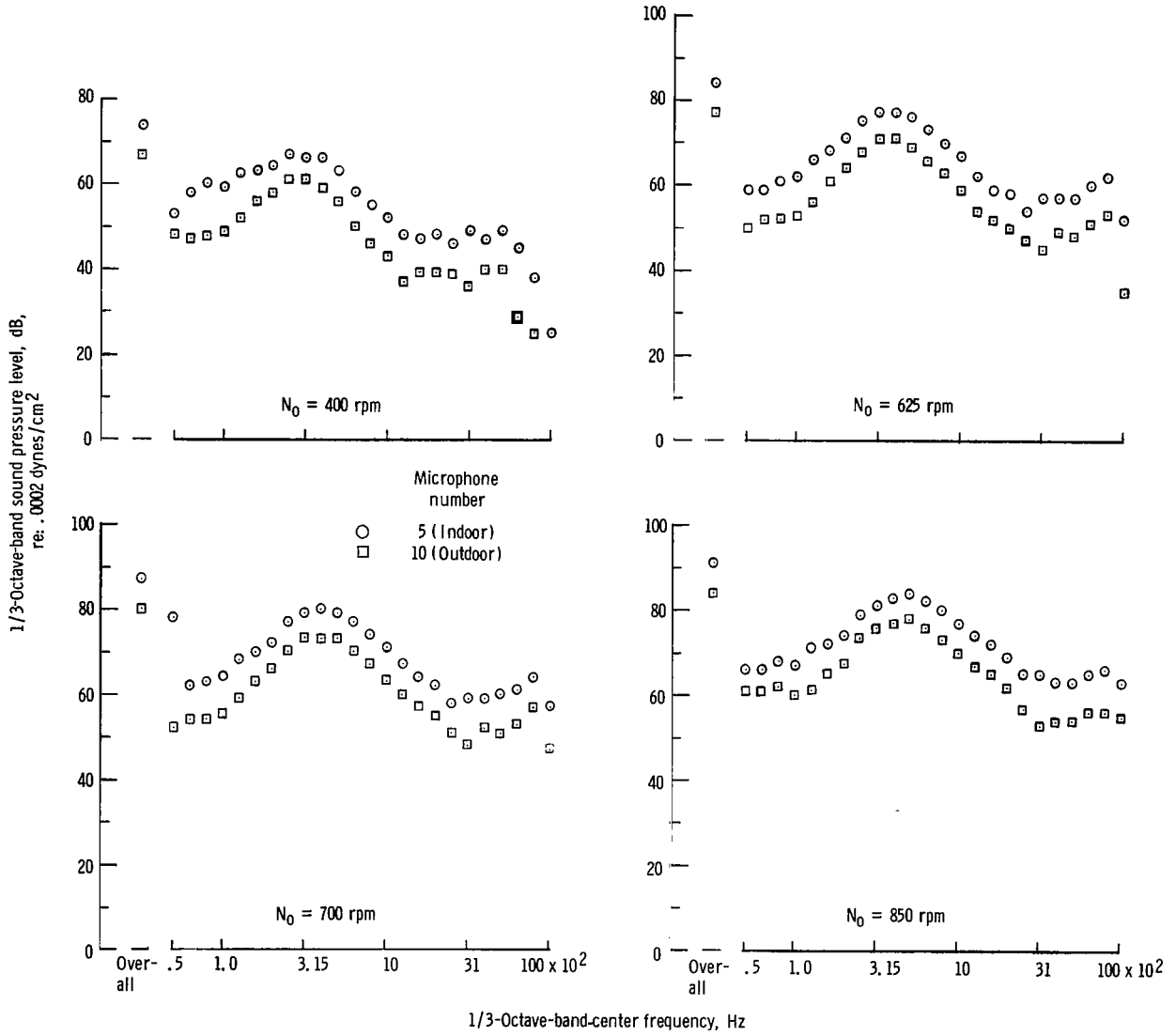


Figure 10.- Comparison of indoor and outdoor noise spectrum for the same microphone position and different rotor rotational speeds for model 10 with zero axial velocity.

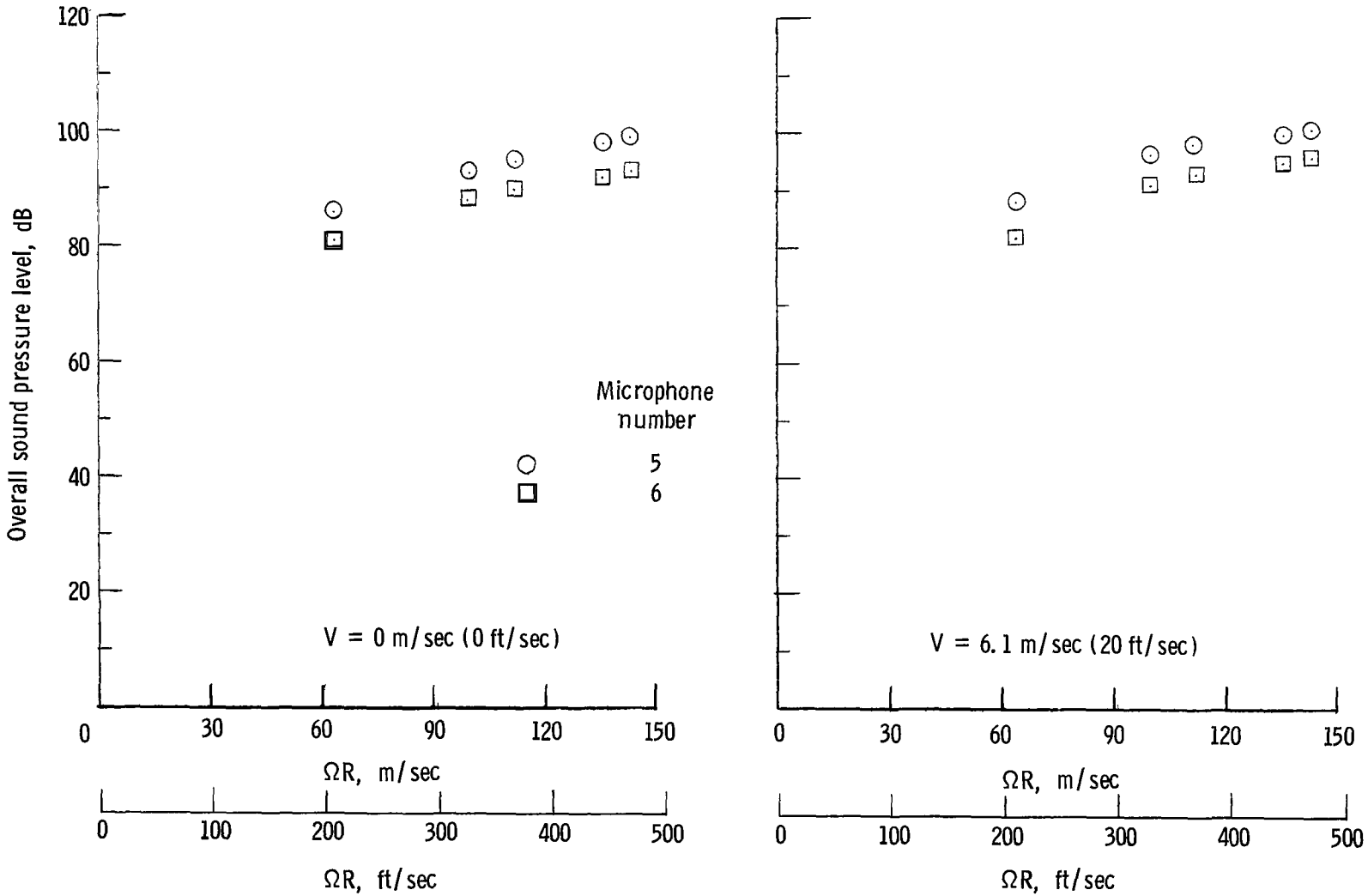
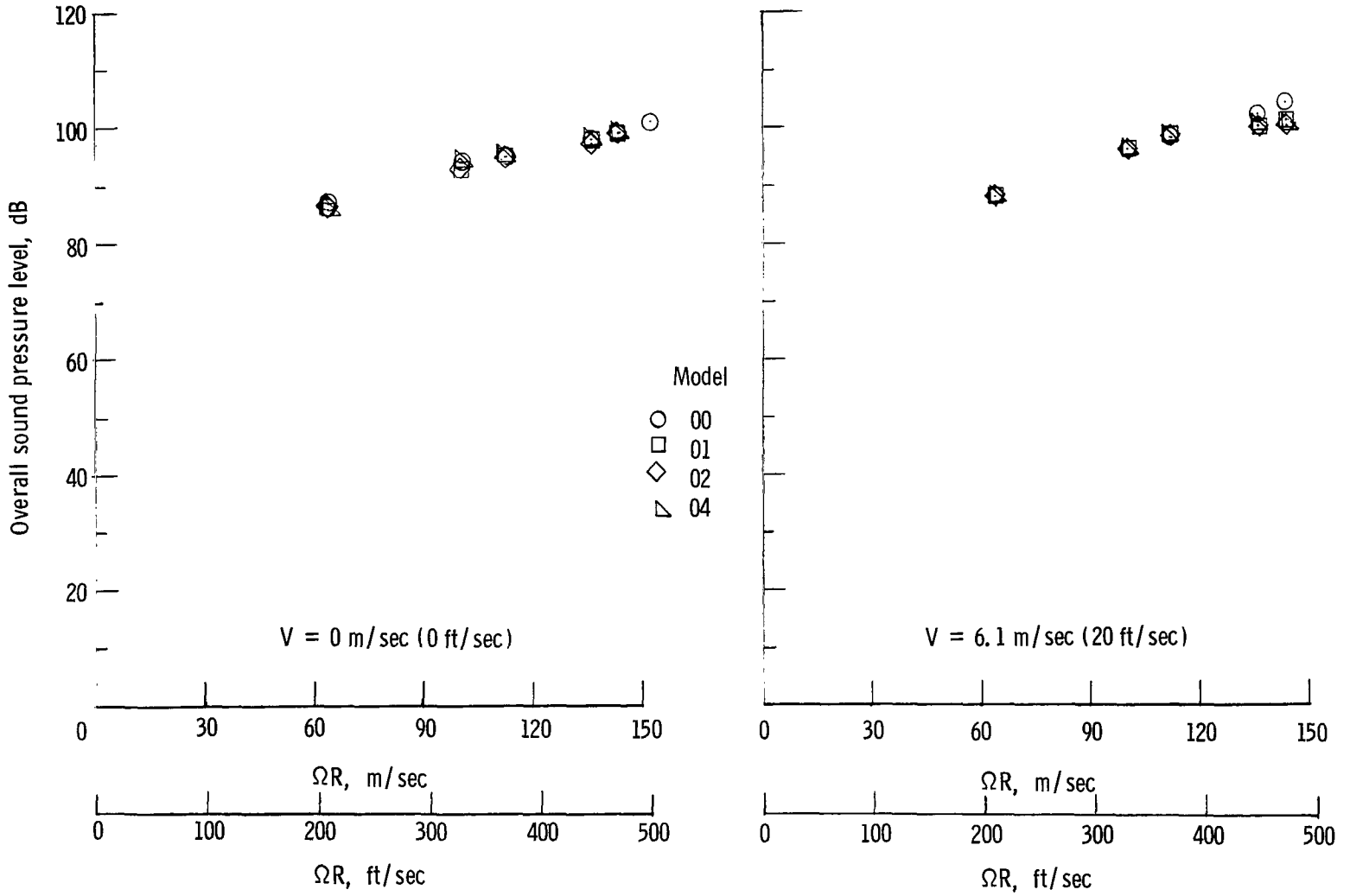
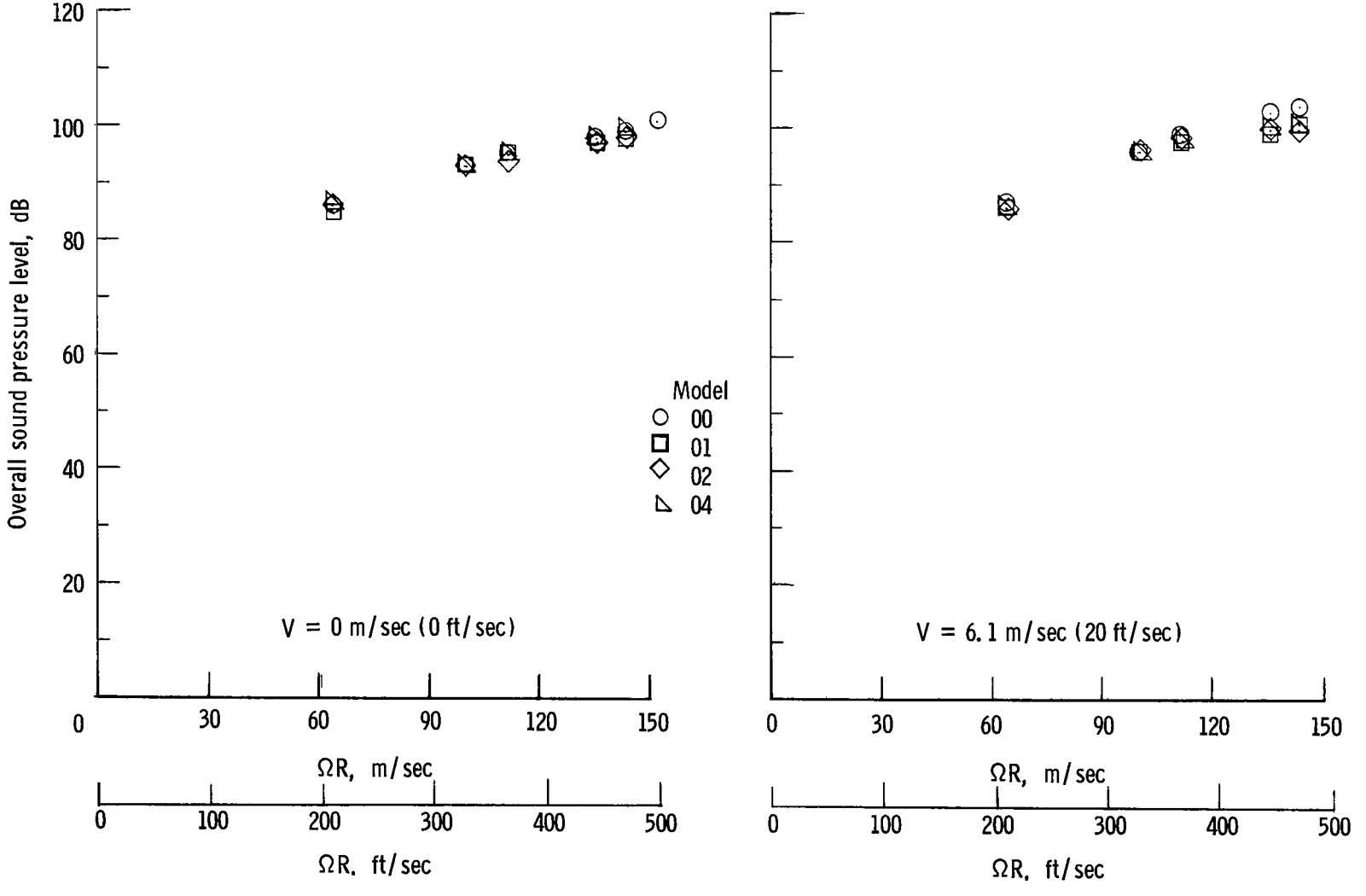


Figure 11.- Evaluation of test-chamber reverberation by means of the inverse square law from the overall sound pressure level of model 01 for different axial velocities and rotational speeds.



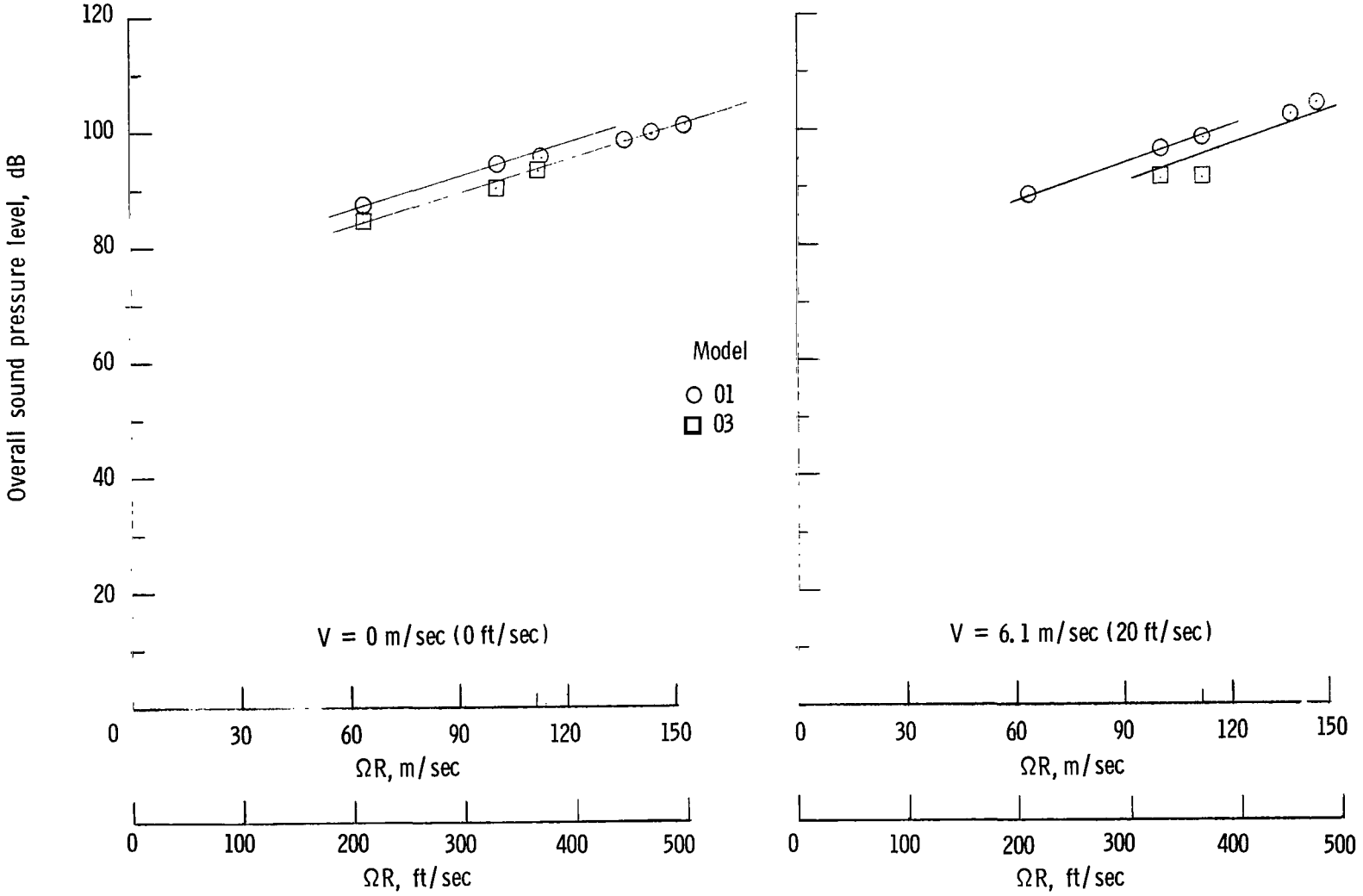
(a) Microphone number 5.

Figure 12.- Comparison of the overall sound pressure level for the cylindrical blade for different blade tip shapes. Data for two different microphones and two axial velocities.



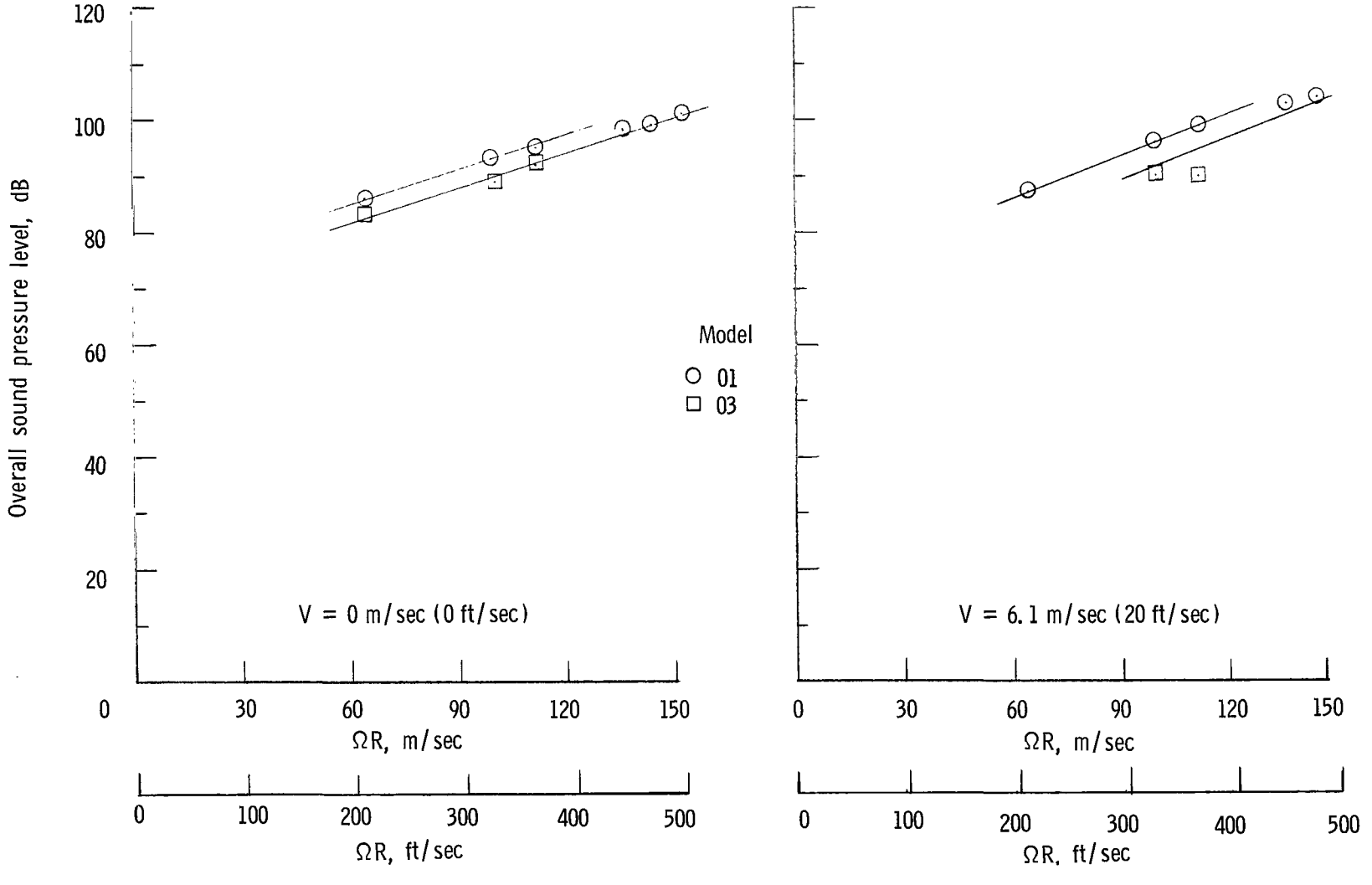
(b) Microphone number 1.

Figure 12.- Concluded.



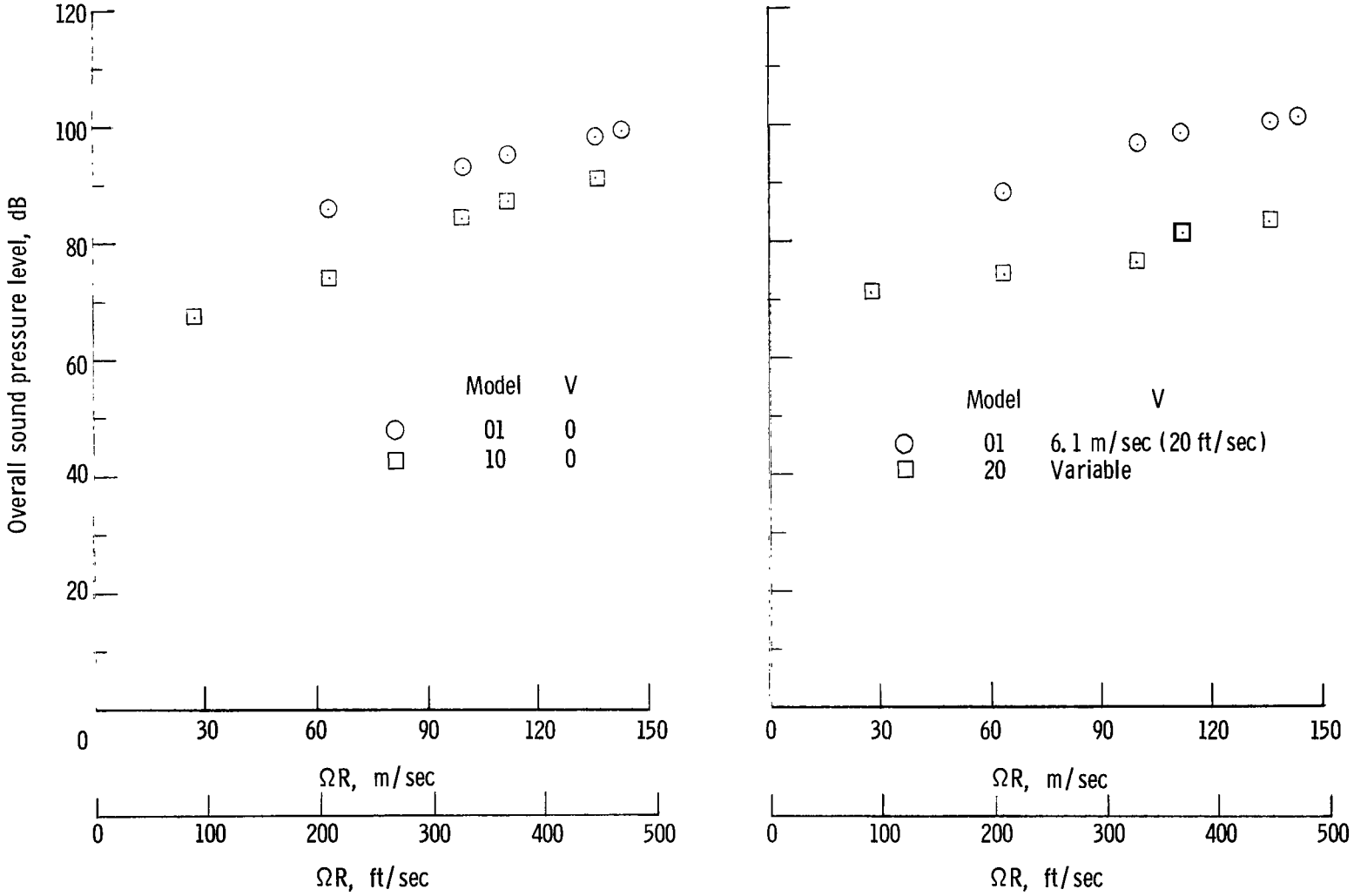
(a) Microphone number 5.

Figure 13.- Comparison of the overall sound pressure level of the cylindrical blade to evaluate Reynolds number effects for two different microphones and axial velocities.



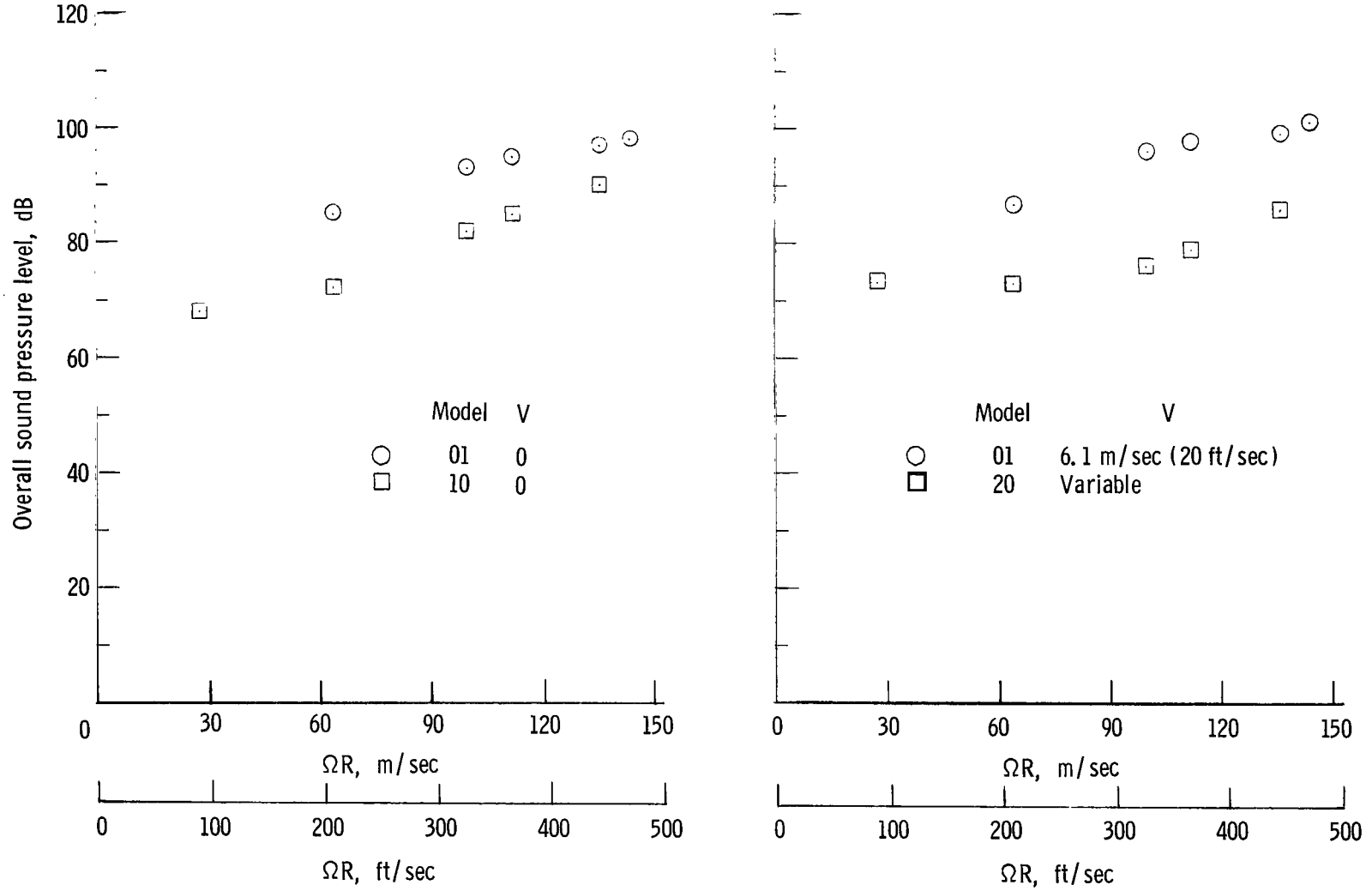
(b) Microphone number 1.

Figure 13.- Concluded.



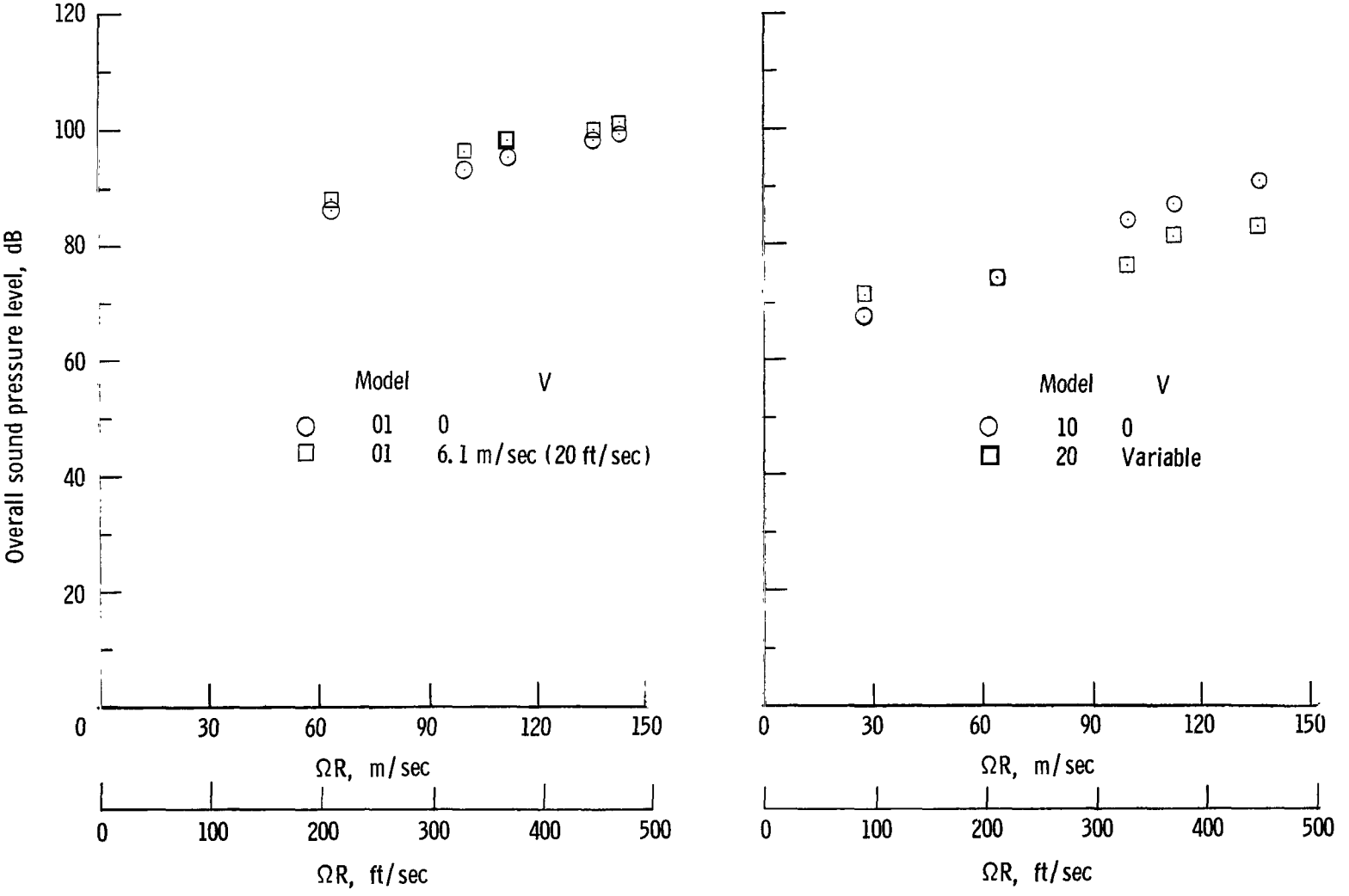
(a) Microphone number 5.

Figure 14.- Comparison of the overall sound pressure level for two different blades with variations in axial velocities for two microphones.



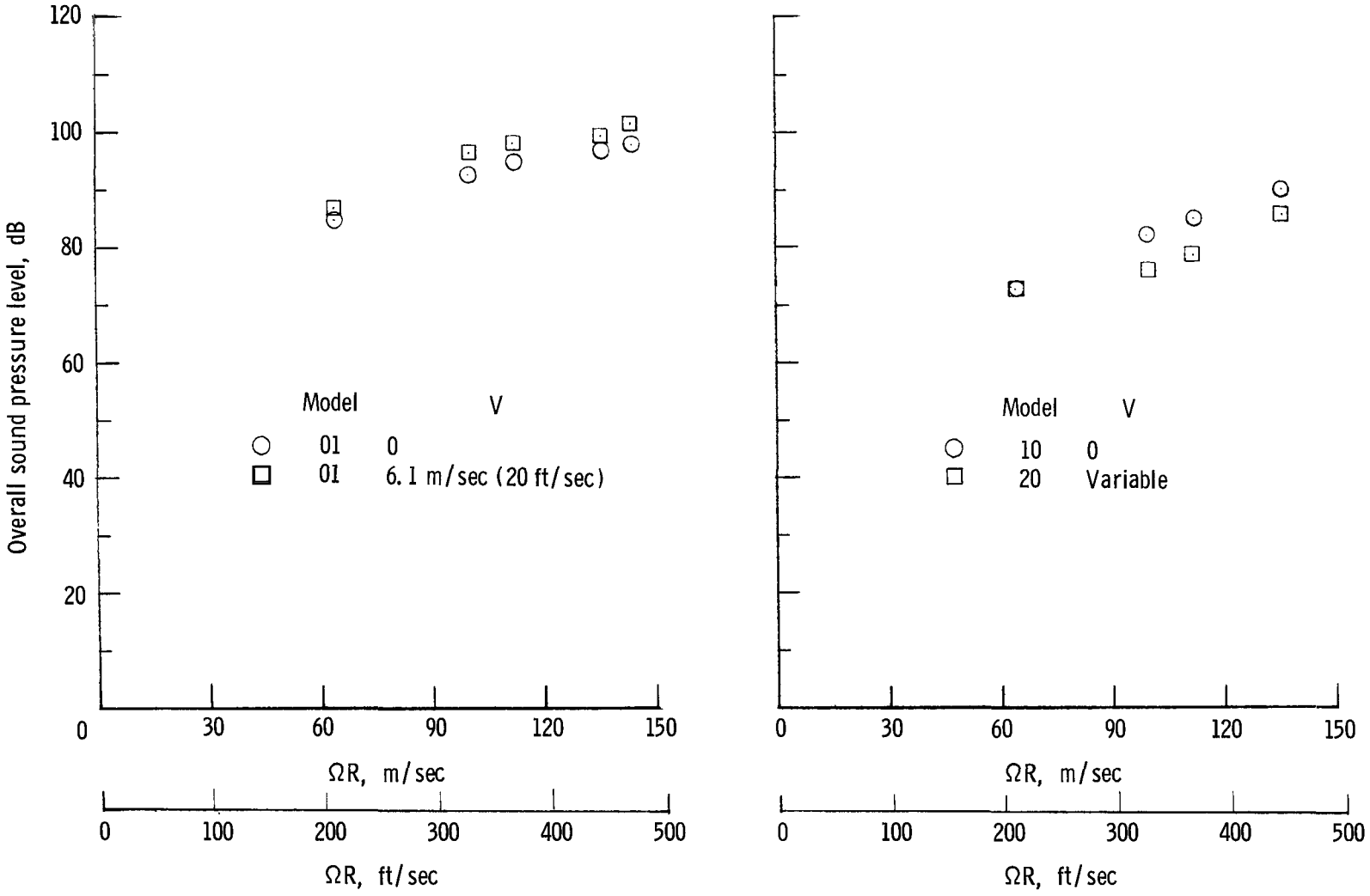
(b) Microphone number 1.

Figure 14.- Concluded.



(a) Microphone number 5.

Figure 15.- Comparison of the overall sound pressure level with variations in axial velocity for two microphones.



(b) Microphone number 1.

Figure 15.- Concluded.

"The aeronautical and space activities of the United States shall be conducted so as to contribute . . . to the expansion of human knowledge of phenomena in the atmosphere and space. The Administration shall provide for the widest practicable and appropriate dissemination of information concerning its activities and the results thereof."

—NATIONAL AERONAUTICS AND SPACE ACT OF 1958

NASA SCIENTIFIC AND TECHNICAL PUBLICATIONS

TECHNICAL REPORTS: Scientific and technical information considered important, complete, and a lasting contribution to existing knowledge.

TECHNICAL NOTES: Information less broad in scope but nevertheless of importance as a contribution to existing knowledge.

TECHNICAL MEMORANDUMS: Information receiving limited distribution because of preliminary data, security classification, or other reasons.

CONTRACTOR REPORTS: Scientific and technical information generated under a NASA contract or grant and considered an important contribution to existing knowledge.

TECHNICAL TRANSLATIONS: Information published in a foreign language considered to merit NASA distribution in English.

SPECIAL PUBLICATIONS: Information derived from or of value to NASA activities. Publications include conference proceedings, monographs, data compilations, handbooks, sourcebooks, and special bibliographies.

TECHNOLOGY UTILIZATION PUBLICATIONS: Information on technology used by NASA that may be of particular interest in commercial and other non-aerospace applications. Publications include Tech Briefs, Technology Utilization Reports and Technology Surveys.

Details on the availability of these publications may be obtained from:

SCIENTIFIC AND TECHNICAL INFORMATION OFFICE

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION

Washington, D.C. 20546